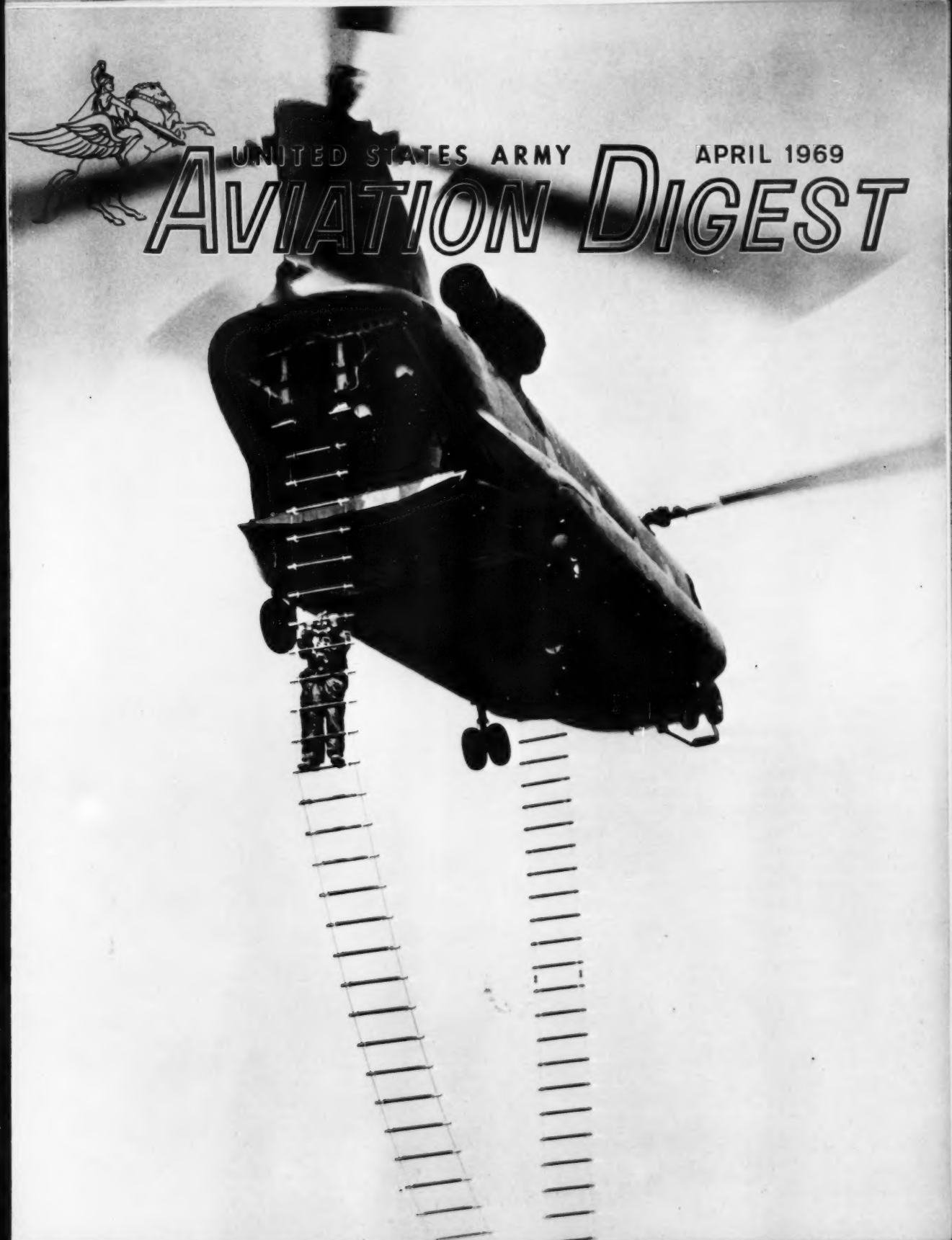
UNITED STATES ARMY
APRIL 1969
AVIATION DIGEST

UNITED STATES ARMY AVIATION DIGEST

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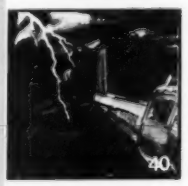

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The mission of the U. S. ARMY AVIATION DIGEST is to provide information of an operational or functional nature concerning safety and aircraft accident prevention, training, maintenance, operations, research and development, aviation medicine, and other related data.

The DIGEST is an official Department of the Army periodical published monthly under the supervision of the Commandant, U. S. Army Aviation School. Views expressed herein are not necessarily those of Department of the Army or the U. S. Army Aviation School. Photos are U. S. Army unless otherwise specified. Material may be reprinted provided credit is given to the DIGEST and to the author, unless otherwise indicated.

Articles, photos, and items of interest on Army aviation are invited. Direct communication is authorized to: Editor, U. S. Army Aviation Digest, Fort Rucker, Ala. 36360.

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VIEWS FROM READERS

The AVIATION DIGEST regrets that the winner's shield was inadvertently omitted from last month's winning article, "Observations Of A Scout." Our apologies to the author, CPT Richard L. Greene.

★ ★ ★

From the 3d Armored Division

The 3d Armored Division is in the process of establishing a museum at the division headquarters in Frankfurt, Germany. All division veterans or other interested persons are asked for their assistance in securing historically significant items for the museum. Items most needed include: weapons, military equipment, photographs, articles of uniform or personal equipment, flags, works of art and unit and individual decorations. Donors will be identified with the item displayed. If possible, donations should be accompanied by a description of the item and its historical significance. Donations and questions should be addressed to the Public Affairs Officer, Headquarters, 3d Armored Division, APO New York 09039.

★ ★ ★

From Boeing Vertol

The U. S. Army's fleet of CH-47 Chinooks have flown more than one-half million hours since the first Boeing-built medium transport helicopter entered the Army's inventory in March 1962. More than two-thirds of the total, or about 350,000 hours, were flown under combat conditions in Southeast Asia.

All three production models of the Chinook are currently serving in Vietnam. The first contingent of A model Chinooks was deployed to Southeast Asia with the 1st Cavalry Division (Airmobile) in September 1965; B model units were first introduced into the theater in February 1968; and the first C model Chinooks arrived in Vietnam in October of the same year.

In Vietnam, the Chinook fleet has transported nearly 3,700,000 passengers and 1.9 million tons of cargo since 1965. In the same period more than 5,700 downed aircraft have been recovered at an estimated replacement value approaching $1.5 billion.

Current production model Chinooks are equipped with Lycoming T55-L-11 turbine engines giving the CH-47C a maximum payload capability of 12 tons and a maximum speed of 164 knots.

To date, more than 560 CH-47 Chinooks have been built for the United States Army.

★ ★ ★

Sir:

The article by Sergeant John S. McCormick which appeared in the January 69 issue of the AVIATION DIGEST prompted some thought.

It is apparent to all who have worked with them that school trained 45J aircraft armament repairmen are well qualified on an individual basis. But is the system which provides these men with their back-up as good as it could be? I don't think so, for the following somewhat generalized reasons.

• The big picture concept of aircraft maintenance is gradually being changed for better or for worse, depending on the opinions of the last man you talked with. The "new look" results in a direct support aircraft maintenance capability being either built into the aviation unit's TOE or attached in the form of the familiar TC detachment. This expansion is designed to reduce aircraft downtime by allowing more technical work to be done without undue duplication and without the former evacuation requirement. Unfortunately, the evolving concept doesn't include armament maintenance. Arguments against this inclusion more than likely are related to personnel strength and equipment requirements.

• It seems that the major armament-related reason for having to evacuate aircraft to the next level of maintenance is for electrical troubleshooting of the armament system's wiring. Occasional problems are also encountered with the hydraulic portion of the armament system; these also may be cause for evacuation and loss of the aircraft. And when even one of a unit's UH-1 gunships is lost, the unit has lost a significant part of its combat capability.

• The normal UH-1 company has two 45Js in grade E-4 assigned; the TC detachment usually has two more E-4s. These personnel can normally handle the unit's armament problems, but they lack the experience and knowledge to work without supervision. Considering that in most units the maintenance officer and his assistants are highly committed in supporting very high flying hour programs and that aircraft maintenance officers receive very limited training in armament maintenance, the normal solution to the problem of supervising the armament people is to appoint an armament maintenance officer. This armament maintenance officer is normally an energetic, aggressive warrant officer pilot from the gun platoon. He starts from scratch, usually equipped only with the knowledge that was presented at Ft. Rucker during the weapons familiarization portion of WORWAC—and enthusiasm. That we have done as well as we have in this field is one more tribute to the quality of these men.

These problems can all be solved. The solution to the first problem is to equip aviation units with direct support level test equipment and the necessary spare parts.

The second problem would be reduced by the first solution, but additional action would be helpful. Train the aircraft electricians and hydraulic repairmen now assigned to the aviation unit or the TC detachment in the basics of the most common weapons systems. These specialists now provide most of the "expert" advice for 45Js in need of help, even though they have virtually no training on armament systems. Train them to provide help.

The third problem could be solved by establishing a familiarization armament maintenance officer's course, two or three weeks long, at Aberdeen or Ft. Rucker for rated aviators who intend to fly guns. The ultimate aim would be to assign one qualified armament maintenance officer to each unit equipped with gunships. Why an aviator? Two reasons. One is that unit strength can be maintained at its present level and the other is that someone has to perform the ultimate test of system operation—the guns have to be flown and fired. Qualify the man who's to do the testing.

Hopefully, someone in the right position will look at these areas. I can't help but believe that this will improve the system—and our combat capability.

MAJ Harold L. Jones
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★ ARMY AVIATION ★

OUTLOOK

Brigadier General Thomas W. Mellen
Director of Developments
Office of the Chief of Research & Development

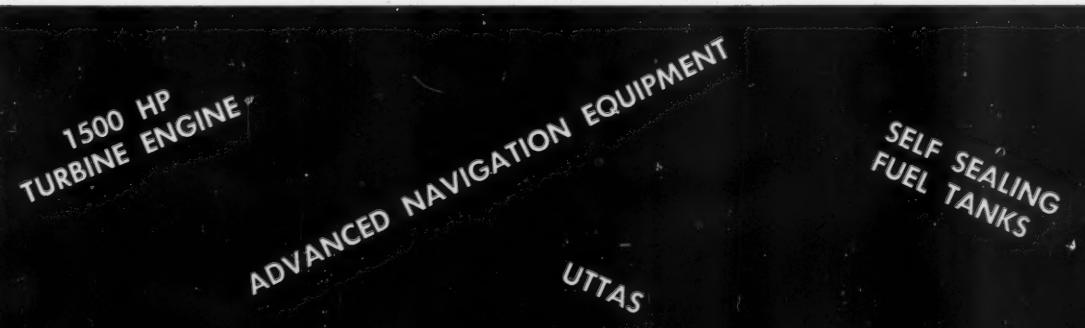
A comprehensive coverage of the Army's current aviation research efforts

NEWSPAPERS AND television programs almost daily portray the role of the Army helicopter in support of free World combat forces in Vietnam. Mobility and firepower provided by the helicopter have added an entirely new dimension to Army ground combat and the phrase "keep 'em flying" has taken on a totally new meaning for the Infantry soldier.

This relatively new capability of Army aircraft did not happen overnight. It is the result of an extensive Army-industry effort over the intervening years since the Korean War. Aviation research and development activities have had a major role in the development and application of new tactics and concepts in the use of the helicopter.

Today's Army aircraft fleet consists primarily of helicopters, with some specific-mission, fixed wing aircraft. This fleet continues to grow. Since 1958 the total number of Army aircraft has increased from 5,000 to 10,600 and total flying time has risen from 1.6 million to 5.3 million hours per year; the flying hours per aircraft per year have almost doubled—320 to 530.

Our experience during this period, in and out of combat, has confirmed that our aircraft must be rugged, easily maintainable under field conditions, reliable, possess long life and meet mission requirements ranging from medical evacuation to delivery of field artillery.



In our endeavor to improve the combat effectiveness of Army aircraft we have tried to concentrate and guide our research to satisfy these known and anticipated requirements. Some of the specific factors or needs that guide our research efforts and fit under the mantle of "improved combat effectiveness" are:

- Aerodynamically efficient aircraft—stability must be such that controlling the aircraft in flight does not become part of the battle for the pilot.
- Full use of lightweight yet strong and durable materials.
- Efficient propulsion systems —in terms of weight and performance.
- Efficient man-machine interfaces—to match the ever increasing add-ons to the pilot's activities and responsibilities.
- Reliable and fully integrated avionics systems.
- Reliable and accurate weapon subsystems.
- Reduced vulnerability to crash and fire damage.
- Elimination of, or vastly reduced, infrared signature of aircraft.
- Total system reliability — which involves a favorable ratio of flight time to maintenance time.
- Effective and efficient training procedures and techniques.

In the area of more efficient propulsion systems, we are looking to the successful development of lightweight gas-turbine power plants, having lower specific fuel consumption at lower dry weight per machine.

Advances in propulsion technology are possible, although there are probable penalties in the form of increased maintenance and weight associated with them. Better engine performance can be achieved through higher compression ratios and higher turbine inlet temperatures. There are possible costs there, too, particularly with direct-lift systems. Recirculation and reingestion of hot exhaust gases can degrade engine performance through thrust fluctuation, inlet flow distortion and loss of power.

In pursuit of better propulsion systems, the Army is engaged in an exploratory program with General Electric Company and Pratt and Whitney. Both are designing and testing a 1,500-horsepower turbine engine. This Demonstrator Engine Program is an exploratory effort to provide input to the next generation of helicopters.

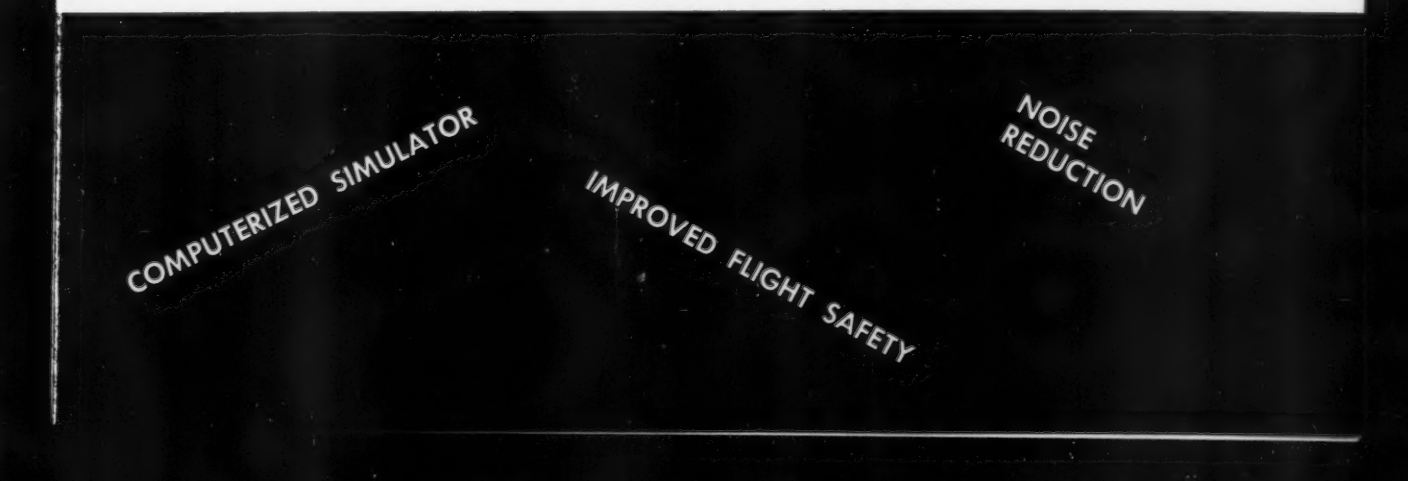
With respect to rotor technology, we are interested in increases in the rigidity of the rotor blade, the reduction of rotor blade stall at high rotational and forward speeds, simplification of rotor head mechanisms and design changes to permit higher allowable blade tip speeds.

The flow phenomena of retreating blade stall, one of the factors limiting helicopter forward speed, is an area under considerable investigation. Army research is concerned and involved with basic aerodynamics of blades, wherein a portion of the blade is submerged in partial or total reverse flow while the remainder of the blade is under relative normal flow conditions. We visualize that many operational advantages can be realized through a better understanding of these transient conditions.

The noise generated by present helicopters detracts from our ability to achieve surprise in combat operations. As you know, the helicopter with its VTOL capability is ideally suited for placing patrols in enemy areas and for insertion of combat troops once the enemy commits his forces. Unfortunately, a degree of this capability is jeopardized because of the unique noise signature of the helicopter; the enemy reacts or hides. The rotor blade is one of the worst offenders in the production of noise. Much of this blade noise is believed to be the result of the advancing blade cutting through the vortex of the preceding blade.

Another source of noise is the engine and associated gear boxes and transmissions, with noise levels in certain cases exceeding 115 decibels. The compressor is a particular offender on the engine. Due to their location within the cabin structure, gear boxes have proved troublesome components of the power train.

In addition to the consideration of tactical surprise, the noise level decreases the efficiency of the crew and the combat soldier. The Army is engaged in research—in-house, by contract, and combined effort with other Government agen-



cies—to reduce the noise signature of the helicopter. A desired goal of this research is the reduction of the internal noise level to no more than than 85 decibels and the external noise level to no more than 80 decibels at a 300-foot range and 100-foot altitude.

In the area of avionics, Army aviation needs relate to aircraft with a high survival communication and navigation capability under hostile, natural and artificial environments. Achievement of this capability has been rather limited to date, but improvements are anticipated through research in the areas of automatic sensors, automatic data processing and advanced navigation equipment for providing an all-weather, 20-hour aircraft operational capability.

The specific application is for low altitude flight regimes required to accomplish direct fire support, observation and surveillance-type missions. The AH-56A Cheyenne has been the first helicopter developed by the Army with deliberate, planned integration of avionics, fire control and armament for satisfaction of total mission requirements.

Research directed to improved flight safety is high on the Army priority list. Injuries and fatalities caused by in-flight or crash fires are the areas of primary interest and attention. Seventy-two percent of our UH-1 crash fatalities are the result of fire. Both the aircraft fuel tank and the fuel itself are targets of this research. We have produced prototypes of crash-resistant fuel tanks which are lightweight and tough enough to resist puncture under severe crash tests. These tanks will also seal bullet holes within a fraction of a second. When a liner containing a coagulant is added to this new fuel tank, a rapid self-sealing capability is achieved. Loss of fuel when the tank is punctured by a .50-caliber tumbled bullet is reduced from 150 liters to one-tenth of a liter. Flight qualification of this type tank in UH-1s are scheduled to begin in June.

Fuel research has progressed steadily until we now have successfully run jet engines on emulsified fuel without any short-term performance degradation. Research is continuing in this area to eliminate corrosive effects on turbine blades.

In the search for better materials for Army aircraft structures, the Army has ongoing research in the area of composites. Studies include filaments, whiskers, matrix materials, micromechanics of composite structures, bonding and joining techniques and fabrication methods. Such basic materials as glass, boron, carbon, graphite and beryllium filaments, as well as metallic and nonmetallic whiskers, are being evalulated as high-strength, high-modulus substrates. New resin and metallic matrix systems, with higher modulus, lower shrinkage, and improved environmental compatibility, are being examined.

The possible advantages that may be realized through the use of composite materials, other than improved structural strength and integrity, are reduced radar reflectivity, improved maintainability and better aerodynamic characteristics. Through results of the composite materials research program, the Army anticipates lightweight composite structural designs that will have application and benefits in advanced and future Army rotary-wing aircraft.

The increasing capabilities—and attendant complexities—of present and future Army aircraft point up the need for new and more comprehensive methods and procedures for training Army air crews. Maintenance of proficiency is equally important.

One task of our training research program is the application of training devices and simulators. We have a continuing program of research directed to improve training techniques and methods for Army aviators and aircraft maintenance personnel. A promising and interesting item in this program is the synthetic flight training system (SFTS).

Our concept for this system is that it will be a fully computerized, flexible simulator for rotary-wing training. The concept formulation phase of development was completed recently and the system will introduce into Army aviation training the very latest advances in training simulator design and instructional technology.

A central computer will service cockpit modules, instructor stations and communications modules of various aircraft now in the Army inventory, as well as future aircraft, such as the Cheyenne. This system will provide the Army its first rotary-wing simulator which will meet Federal Aviation Administration standards for simulators for inflight instrument instruction and transition training.

The needs and activities I have described to this point are important to successful mission accomplishment of future Army aircraft. However, in my opinion—and I believe supported by Army experience in Vietnam—the key parameters to that successful mission accomplishment are reliability and maintainability.

We have a clear need for improved total aircraft system reliability and maintainability. The Army basically moves and fights on the ground, normally under unimproved and often remote field conditions. Since reliability and long life are reduced by dust, dirt, mud and rain experienced on a

daily basis, the task imposed on Army aviation research and engineering is a very demanding one.

The field Army lives and works in the combat environment. Little change is made to the climatic and environmental conditions, and Army aircraft must "live with the troops." There are clear tactical advantages to be realized by operating from a dispersed, ever-changing, unsophisticated and natural environment. In turn, however, this kind of operation demands from Army aircraft a rugged, reliable, self-contained component and total system that can be maintained under "field" conditions without overly sophisticated tools, without highly skilled maintenance personnel and which requires a minimum of ground support and special equipment.

Our long-standing practice of replacing certain aircraft parts at prescribed flight-hour intervals is inefficient. It is wasteful of man-hours and money. Worse, it is responsible daily for reducing the number of aircraft ready to perform combat missions. We do have a research and exploratory development program to provide diagnostic equipment which can sense the conditions of vital parts and eliminate needless inspection and replacement of components.

The results of the research programs I have mentioned, plus many more, are to be incorporated into our future aircraft systems. The first system to incorporate as many as are available in the time frame involved will be the Utility Tactical Transport Aircraft System. Referred to as UTTAS, this is the projected replacement system for the current UH-1 series aircraft. The Army intends UTTAS to be the most efficient and effective aircraft on the battlefield that American industrial ingenuity can provide. To accomplish this, technology must be pressed in the direction that will provide those improvements essential to mission accomplishment.

Based on extensive experience with the UH-1D in Vietnam, the biggest bonus may likely be obtained by attaining the highest possible standards in reliability and maintainability—that is, a major reduction of the ratio of maintenance hours to flight hours. The performance characteristics of the UH-1D are reasonably approaching those desired for a troop-lift aircraft for the Army in the field.

The benefits that can be projected to future air-assault operations resulting from substantial increases in individual aircraft performance are insignificant when compared to the tactical advantages of having a fleet that is reliable and available when the field commander needs it. Thus, in the UTTAS the Army seeks modest improvements in performance and major improvements in terms of reliability and maintainability.

The Army recognizes that most advances will be evolutionary in nature. To date, however, we accept breakthroughs gratefully, and in the past have even been accused of programming them. Substantial progress has been made on Army aircraft systems through research. Rotary-wing aircraft technology has advanced; so has engine technology; techniques for training pilots have improved; lighter weight and more efficient propulsion systems are on the horizon; and integrated avionics and weapon systems are being demonstrated in the Cheyenne.

All of these results contribute to give the Army safer aircraft with improved performance. That we are attaining concurrent simplicity has yet to be completely demonstrated. Aircraft noise, reliability and maintainability continue to be areas requiring hard work and resource support.

The noise generated by assault helicopters, such as the Hueys below, detracts from our ability to achieve surprise in combat. A desired goal is to reduce the external noise level to no more than 80 decibels at a 300-foot range and a 100-foot altitude

Stairway TO THE Stars

A STAIRWAY to the stars may be in the future of the ground-pounding soldier. A new high speed lowering/retrieval system for use on the CH-47 Chinook has been developed by U. S. Army Natick Laboratories. With no more effort than it takes to punch the button of an elevator, the system can pick up and lower cargo, litters and personnel.

Basically the equipment consists of a continuous ladder or stairs that runs over the ramp, through the cargo compartment and out the rescue hatch. Inside the cargo compartment is an auxiliary power unit that drives the belt in either direction at a rate as high as 10 feet per second. All the soldier has to do is step aboard the ladder and the engine does the work.

The ladder consists of two ¼-inch steel cables that support aluminum rungs at one-foot intervals. Straps are attached to help exhausted or injured soldiers. Additional sections may be added to the ladder even while the helicopter is in flight.

The ladder mechanical drive system is powered by a 43 horsepower, aircooled automotive gasoline engine. Power is transmitted to the ladder through a torque converter to a chain driven carriage. The equipment has a self-braking system that will stop the ladder with up to a 6,000 pound load.

The power unit is mounted on wheels and the entire system can be installed in a CH-47 in less than an hour. No retrofit is necessary since existing fuselage hard points are used. The basic supporting structure, ladder guides and drive carriage are constructed of aluminum alloy.

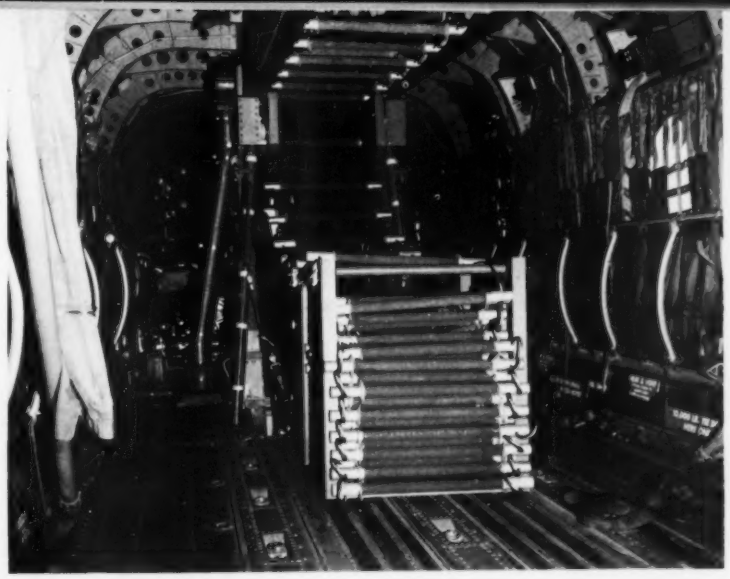
The idea is the brain child of the personnel of Natick Laboratories, Natick, Mass. Aerostructures of Menlo Park, Calif., was given the contract to engineer and develop the idea.

In demonstrations held at the Natick Laboratories and at Sharpe Army Depot, Lathrop, Calif., cargo, litters and personnel were lifted and lowered from a Chinook while it hovered 100 feet above the ground.

Besides being easier on the soldier, the equipment is said to be much faster than the present troopers' ladder. According to Natick Labs 20 men can be hauled aboard the aircraft in four minutes as compared to 40 minutes with conventional equipment. This reduces the time the helicopter must sit as a motionless target.

Under circumstances where trees or other obstacles make the wide loop unusable, the system can be used as a single line hoist. In an emergency the whole system can be jettisoned.

The system now being demonstrated is considered experimental for the purpose of evaluating the concept. It weighs 2,200 pounds and was built from existing hardware. The production model should weigh between 900 and 1,200 pounds.



Above: On the left rear is the 90 degree gear box and the torque tube drive shaft which runs to the overhead drive carriage. The equipment has a throttle control allowing the speed to be adjusted from zero to 10 feet per second

Below: The endless ladder passes over the aft ramp and through an overhead structure, then down the lower hatch in the floor to form a loop to the ground. The two one-fourth inch steel cables support, at one foot intervals, anti-slip coated aluminum rungs

Gas Turbine Simulators

. . . do everything but take off and fly

Clementine R. Bowman

An instructor gives cockpit instructions to a student in the OH-6 Cayuse Helicopter Repair Course at the Army Transportation School, Ft. Eustis, Va.

AT THE U. S. Army Transportation School, Ft. Eustis, Va., there are two valuable training aids which deliberately make trouble for the students.

The training aids, called computerized turbine engine simulators, can reproduce various malfunctions found in aircraft turbine engines. In fact they do everything but take off and fly.

The turbine engine simulators, the first of which was delivered in January 1965, have paid for themselves by elimination of live engine losses in the field. Each simulator consists of seven units. Both simulators contain an engine display panel with 12 lighted engine instruments and a master caution panel; two animated fuel controls, one for each engine; the trouble selection station and an analog computer.

One has the capability to simulate the T-63A-5A engine, installed in the OH-6A Cayuse and the T-53-L-13 installed on the UH-1H Huey. The other simulator has two cockpits which depict the T-53-L-11 engine used in the UH-1D and the T-55-L-7 engine which is used in the CH-47A Chinook.

During the last fiscal year 12,000 students have been trained on the turbine engine simulators in classes at the Transportation School. The simulators are used on an average of 10 hours daily. The reliability of these devices has been proven by a record of less than 200 hours of downtime for repair and maintenance since they were delivered to Ft. Eustis.

A third simulator is programmed for delivery in 1969 which will depict the T-64GE-16, the engine used in the AH-56 Cheyenne and the T-55-L-11 engine used in the CH-47C.

After delivery of the third engine simulator, they will be utilized in instructing turbine engine troubleshooting to mechanics of the multi-engine fixed wing aircraft, single and multi-engine helicopters, aircraft engine repairmen, fixed and rotary wing technical inspectors, aviation maintenance officers and aviation maintenance test pilots. In all, this instruction covers 11 of the Army's aviation military occupational specialities.

The complexity and cost of the turbine engine has made the old methods of troubleshooting instruction on a "live" engine impractical. These simulators can duplicate by flashing lights any live engine function, with accompanying sound effects.

Both simulators depict a large action engine in perfect running condition. By the use of the analog computer the malfunctions are introduced into the simulated engine, including changes in sound or instrumentation as it suffers the effects of the various induced malfunctions. Then the engine simulator will depict the malfunctions as they develop.

There are over 40 different types of malfunctions or combinations of malfunctions which can be fed into the engine simulator by the analog computer.

Some of the malfunctions include ignition failures, hot starts, overspeeds of the engine compressor or powertrain system, high or low oil pressure or oil temperature and engine surges.

These simulator training devices are the first of their type to be used for troubleshooting at the Transportation School. After the student settles himself in the cockpit the assistant instructor, through the trouble selection station, programs the analog computer for an engine surge.

The student starts the simulated engine. The display panel lights begin the operation which represents an effect of air and fuel flow ending in combustion. As the engine gains speed the large instruments on the display panel indicate normal operation with all readings green. When the engine is accelerated to full throttle the class is aware that trouble exists. The exhaust gas temperature has started to rise rapidly and the display lights start a rapid pulsation, accompanied by a loud metallic popping noise similar to the sound of a machinegun. The student has just experienced an engine surge through the sound effects on the trainer. A pilot or mechanic can easily identify this sound.

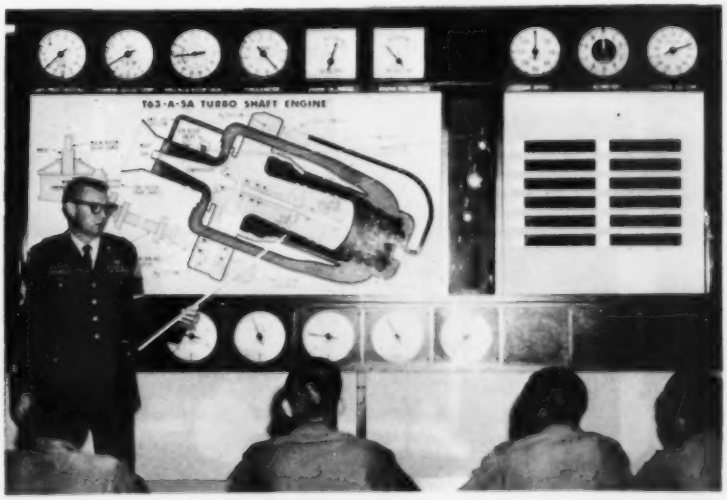
An engine surge consists of a reverse flow of combustion gases. It causes loss of power and excessive high exhaust temperature which results in the destruction of the power turbine wheels. If this condition is not controlled it will cause complete destruction of the engine. Although it could happen with acceleration or deceleration of an engine, it usually occurs with acceleration.

But on the simulator no damage is experienced. The assistant instructor has only to flick a switch on the trouble selector and the malfunction disappears.

After this exercise has been completed on the training device the instructor explains the malfunction, including the cause, and the corrective action required when an engine surge is experienced. If the students were to take the wrong corrective action while working on a live turbine engine it could very well mean the loss of the engine.

With the simulators students can be taught to perform satisfactorily in practical instruction on the operation, troubleshooting, adjustment, repair and calibration on "live" gas turbine engines in a test cell environment. Indepth training now can be given to this phase of troubleshooting instruction by realistic operational simulation in the classroom.

Indepth training now can be given to troubleshooting instruction by realistic operational simulation in the classroom



IFR Combat Assault

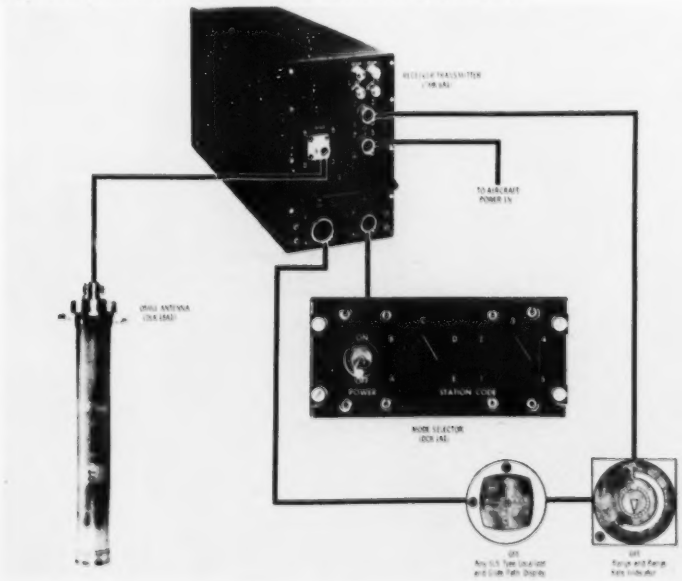
The Army is testing a small, portable instrument landing system that could make all-weather combat assaults a reality

Major Wiley W. Walker

RECENT DEVELOPMENTS in electronic technology are bringing the day of instrument landings in combat assault missions close to a reality. The Simplified Tactical Approach and Terminal Equipment, "STATE," is currently being evaluated by the U. S. Army Aviation Test Board at Ft. Rucker, Ala. STATE is one of several small portable instrument landing systems that can be carried and operated by two men. According to the manufacturer, it is simple, safe, inexpensive and easy to maintain.

The equipment comes in two parts: a 70-pound ground station consisting of an antenna array and a power supply and a less than 20-pound airborne package. Primary power for the ground station is furnished by a small (.2 horsepower) engine. Alternate power sources are available by using a battery or any 28 volt direct current (VDC) external power source. The airborne equipment uses standard 28 VDC aircraft power and provides the pilot with range from the ground station out to 10 nautical miles and rate of closure/departure to the station. Final approach localizer and glide slope are conventionally displayed on any standard aircraft ILS display.

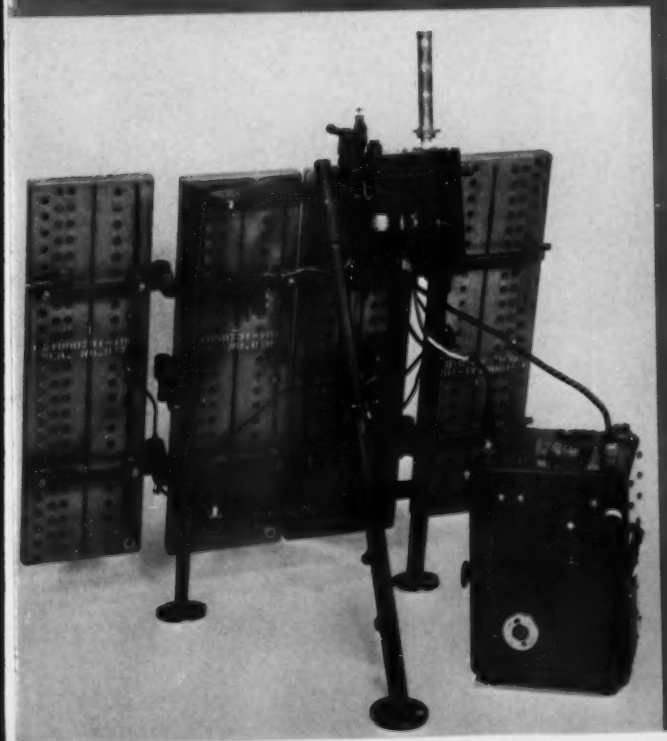
Airborne equipment used in conjunction with the Simplified Tactical Approach and Terminal Equipment System is shown below



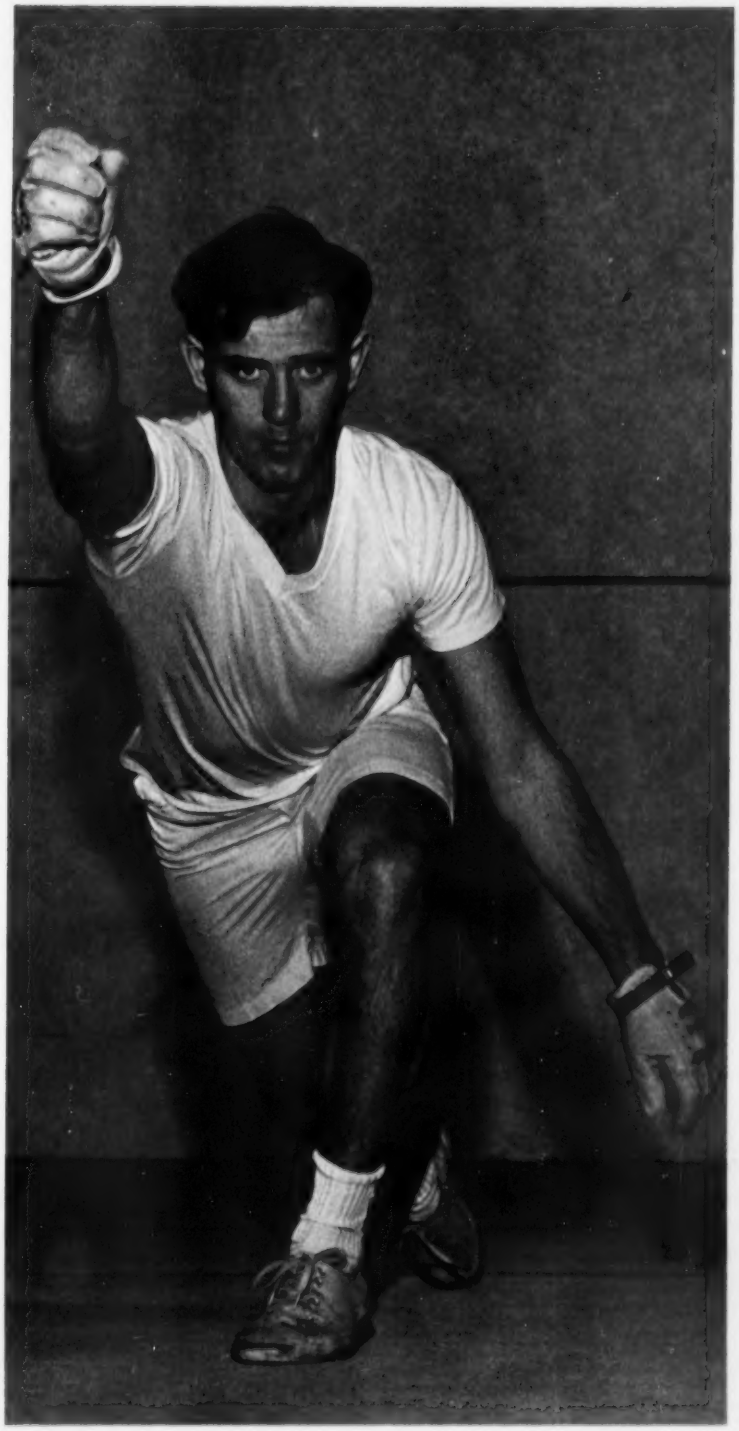
The STATE operates on an interrogation/reply concept with the ground station remaining passive when no suitably equipped aircraft are within 10 nautical miles. All transmissions from both the ground and airborne stations are line-of-sight in the C-Band radar frequency range. Twenty-five readily selectable codes are available to select the proper ground station in a high density STATE environment. Glide paths from 0 degrees to 30 degrees are provided by the use of a simple protractor and level bubble. A small telescope is used to boresight the glide slope and localizer to insure obstacle clearance. A designed safety feature is a tilt switch which activates a "tilt" light on both the ground and in the aircraft if the ground equipment is inadvertently knocked off the intended boresight.

STATE equipment is designed to provide obstacle clearance approaches to tactical LZs for multiple aircraft, however the problem of IFR formation flying must be resolved before all-weather combat assaults will be a reality. The present-day application to single ship missions for medical evacuation, patrol extraction and resupply would greatly enhance Army aviation's combat support mission. Many aviators have seen days in Vietnam when a cloud deck prevented mission accomplishment—if STATE proves adequate for the Army's mission, the goal of "adverse weather, day-night" tactical capability is nearer.

Above, a Huey approaches the portable instrument landing system during tests. Below, the back view of the ground equipment. Right, front view of same equipment



Physical Fitness

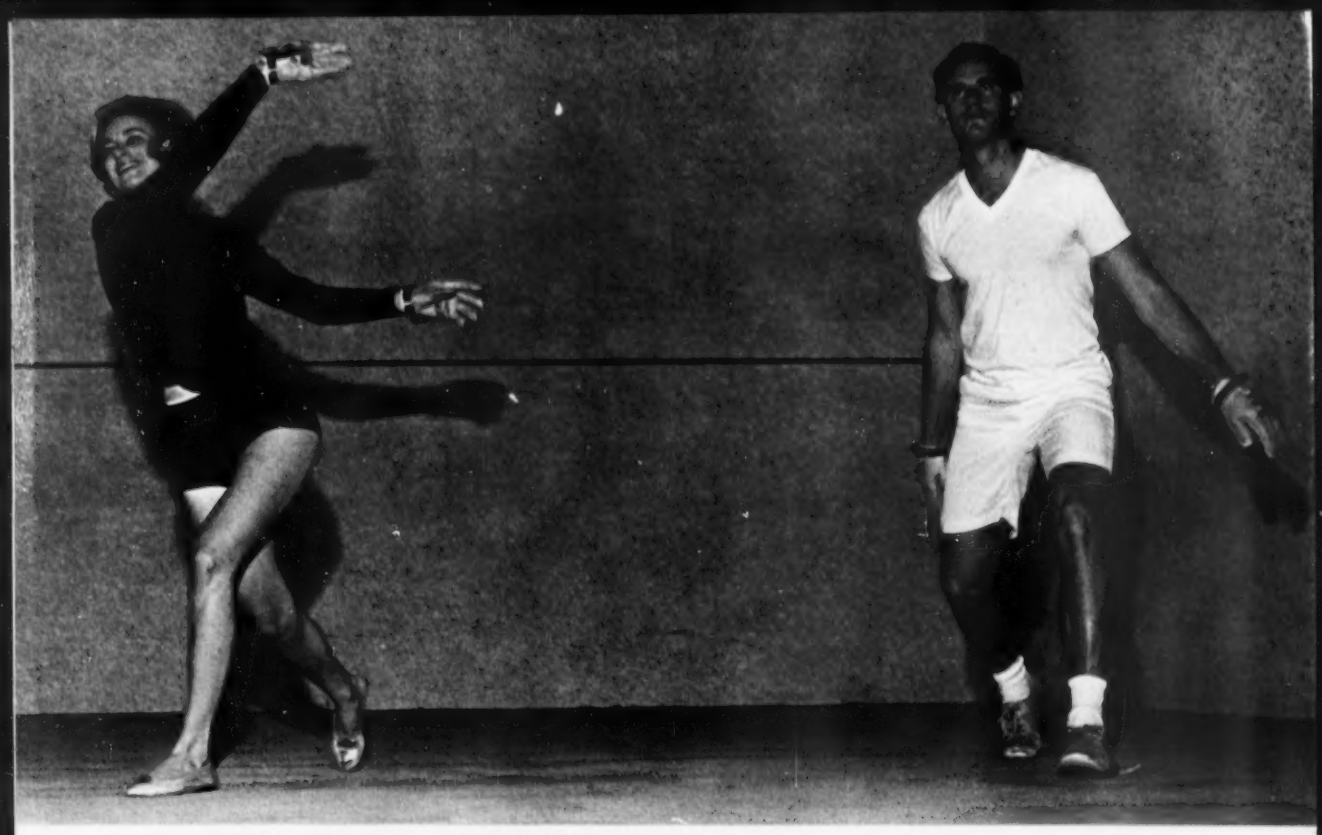


Unless the Army aviator takes it upon himself to start a program of daily physical exercise, on his own time, he more than likely will be lacking in physical fitness

In return for just one hour a day, which can be an enjoyable hour, you can keep a healthy body, an alert mind and live longer

Captain Alfred S. Rushatz

PHYSICAL FITNESS HAS been receiving more and more attention in the past few years than ever before. Our government has established the President's Council on Physical Fitness with hopes of improving our nation's physical condition. The Armed Forces are very much concerned with this situation and through training man-



The right partner will inspire a good physical fitness program

uals and exercise programs strive to keep and improve the physical fitness of our nation's fighting forces. For a great majority of the enlisted men and officers in the U. S. Army, physical fitness comes as a by-product of their everyday duties.

An Infantry company commander, after rendering his reveille report, double times his unit to their PT area and leads them through a generous sampling of the daily dozen and at least a half mile run. This daily routine alone is normally adequate to keep anyone physically fit. In addition, however, our CO is obliged to make appearances on compass courses, map courses, obstacle courses, various ranges, practice patrols, bivouacs, parades and various other physically demanding duties. It is quite evident that this officer has little difficulty keeping himself in good physical condition. He stays physically fit simply by doing his job.

An aviator, claims an instructor pilot, finds that his duties don't require a great amount of physical exertion. When he is not doing battle with flight scheduling, he is running a stagefield tower, giving check rides or riding right seat as an instructor pilot on a daily flight or cross-country. At the most it is daily mental gymnastics, but, except for pushing a pencil or throttle lever, there is next to no physical exertion connected with aviation duties. Thus, unless the Army aviator takes it upon himself to start a program of daily physical exercise, on his own time, he probably is lacking in physical fitness.

And now the question—who needs it? Aviators are not expected to be "follow me up the hill" type soldiers. It doesn't take a great deal of physical strength to fly an aircraft. (The old instructor pilot can still be heard yelling, "Don't push and pull that stick, just think about moving it.") So why go through the seemingly non-rewarding drudgery of keeping in good physical condition?

There are many answers to this question. To say that a physically fit individual's work, thought processes and end product stand above those of the individual who cares nothing about his physical fitness —and looks it—answers the question best.

Because of the benefits derived from being physically fit, organizations such as the President's Council on Physical Fitness have come about. Commanders of the Armed Forces strictly enforce physical fitness programs for the same reasons. Hundreds of thousands of dollars are spent annually at health clubs, YMCAs, etc., with the same goals in mind. In addition we read medical reports almost every day

stating that being in good physical shape produces generally good health, a stronger heart, better circulation and strong lungs. Finally, being physically fit is personally rewarding. In return for just one hour a day of your time, which can be an enjoyable hour, you can maintain a sound healthy body, an alert mind and live a longer life. What could be more rewarding?

Where do we find that one hour a day to devote to our physical fitness? There are three times during the day when this hour should be available; the first being the noon hour. At most Army posts in CONUS it shouldn't take more than 15 minutes to drive to the post gym, and start your workout. Allowing 15 minutes to shower and get back to work gives you a 30-minute workout, which if it's well planned, will maintain a good state of physical fitness. Using the noon hour for this purpose also helps pass up the hamburger and french fries routine if you are "diet-minded."

Not everyone can break away from the office for an hour in the middle of the working day though and this brings us to the second time of the day to get our exercise. After duty and before the evening meal. Admittedly as convenient as this time may sound it is not always the best. Gyms, tennis courts and handball courts usually are crowded with unit athletics, little league sports and other post functions. However, it is better to get your workout during this time than not at all. Most posts have a reservation system set up allowing you to be sure of a time the recreational facilities will be available for your use. In addition you can form your own leagues, teams and tournaments, providing even greater utilization of post recreational facilities. Furthermore, being a member of a team or being entered in a tournament adds to the enjoyment of your physical exercise. So much so in fact that you can easily find yourself looking forward to your workout rather than thinking of it as a necessary drudgery.

About an hour after the evening meal is another ideal time for physical exercise. Most all posts keep their recreational facilities open until 2100 hours or later. In the summer months this usually includes lighted tennis courts. During this time facilities usually are not crowded and again the reservation system can assure you of a time.

Several articles published profess that the noon meal should be the large or heavy meal of the day because we then have a whole day of activity ahead of us to aid in its digestion. Eating a large evening meal and going to bed four hours later with no activity between is not supposed to be the best thing for the digestive system. However a large noon meal is almost always impractical, especially for married men. Therefore participating in physical exercise an hour or so after the evening meal should be an aid for a more efficient digestive process in addition to keeping in good physical shape.

And, of course, we have our weekends. Most post facilities, however, are more crowded during weekends so reservations should be made well in advance if your workout includes a game of basketball, handball or tennis. When using the weekend as part of your physical exercise program use only one of the days, preferably Sunday afternoon. This allows you to take care of personal business on Saturday.

Getting your physical exercise just on weekends, however, even using both days will not be sufficient for most to keep in good physical shape. A program of physical exercise four to six days out of the week will keep you in good physical shape, with surprisingly little effort once you make up your mind to follow your program. Depending on weekends alone to get a "week's worth" of physical exercise will not work.

By now it should be evident that even the busiest of us have the time to devote to our physical fitness. As for what physical exercise should be used during this time there are numerous publications that fully explain good physical training programs. For example, there is the Army TM on physical training and the USAF has a pamphlet dealing with physical exercise and diets for pilots. There are hundreds of health magazines on the commercial market today, all suggesting various types of physical training programs. If you can't find a program that you like, plan one yourself, or better yet, plan one with group participation in mind.

At the United States Military Academy there is a voluntary physical fitness program established known as "happy hour." This program incorporates about 30 minutes of exercises similiar to the exercises in the daily dozen and about 30 minutes of organized sports. Cadets participate in this program three times a week from 1600 to 1700 hours.

Actually, as long as you get a physical exercise program that has you moderately tired and sweating after an hour, and stick to it, you are well on your way to improving or maintaining your physical fitness.

As you can see, I have suggested no proved body-building or instant muscle-man type programs in this article. What I have tried to do is drive home the fact that physical fitness is important and very much the concern of our commanders and our government. No matter how tight a daily schedule one has, there is an hour some time in the day that can be devoted to physical fitness. It does not take a great deal of time or effort on your part to reap the rewards of being physically fit.

Advancements and improvements in operators and crewmembers checklists have resulted in current, standardized, user-oriented checklists (CL) throughout Army aviation

Major William H. Gardner

THIS ARTICLE, the third in a series, is concerned with operators and crewmembers checklists. The first article, "A Wink, A Nod and a Smile," in the February DIGEST was a humorous story of an Army aviator who dreamed he had crashed as a result of failure to follow his checklist. The article "At Last—User Oriented Checklists and Operators Manuals" in the March issue presented, in essence, where we've been, what's going on now and where the Army is going in these areas.

One of the "places" where the Army is going is the new Department of the Army approved crewmembers checklist (CL) to be used not only at the aviation schools but also by Army aviators worldwide. The new checklists became available early this year for the following aircraft: UH-1A, B, C, D and H; AH-1G; CH-54A; CH-47A, B and C; OH-6; O-1A and E; U-8D and F; U-21.

The new checklists will have one or two pages devoted to "General Information and Scope" and consist of three main sections: Normal Procedures, Emergency Procedures and Performance Data.

The size of the new checklist is 4 by 6½ inches and each page is designed to fit into TM 1500-1. This ringbinder containing 60 plastic inserts is authorized on the basis of one per Army aircraft worldwide to include those now in Vietnam. (Figure 1).

The Normal Procedures Section lists those procedures required for normal flight.

The section on Emergency Procedures is broken down into the following 10 classifications in sequence:

(1) Engine (ENGINE)
(2) Propeller/Tail Rotor (PROP)
(3) Fire (FIRE)
(4) Fuel (FUEL)
(5) Electrical (ELECT)
(6) Hydraulic (HYD)
(7) Landing and Ditching (LDG/DTCH)
(8) Flight Controls (FLT CONT)
(9) Bailout or Ejection (BAILOUT)
(10) Armament (ARMT)

In TM 1500-1 there are 10 inserts for each of the above. The index tab for each insert is shown in parentheses.

The Performance Data Section consists of a performance data card and the necessary takeoff and landing performance data charts.

The following "NOTE" appears in the General Information and Scope Section of all the new checklists:

"This checklist does not replace the amplified version of the procedures in the operators manual (TM5-XXXX-000-10) [dash 10], but is a condensed version of each procedure." This statement underlies one of the significant improvements found in the new checklists.

It is important to remember that a checklist is nothing more than a reminder of a sequence of events. In the case of the emergency procedures page, for example, the requirements of the CL are identical to those for the normal procedures, except that the information is taken from the more detailed procedures in the emergency procedures portion of the operators manual. In the performance data pages, the selected performance data charts are reproductions of those in the operators manual.

There are several symbols which precede the numbered steps in the Normal Procedures Section:

(*) Indicates performance of steps is mandatory for all "thru-flights." A "thru-flight" is defined in the operators manual as those flights "when the aircraft is flown by the *same* flight crew during tactical or administrative missions requiring intermediate stops." Under these conditions only certain required checks are necessary for safe operation and the flight crew need not perform all the preflight checks required otherwise for beginning flights.

(N) Means performance of the step is mandatory for "night flights."

(★) Indicates a detailed procedure for this step follows the Performance Checks Section at the back of the checklist. Examples

Figure 1

TM 55-1520-220-CL

DEPARTMENT OF THE ARMY TECHNICAL MANUAL

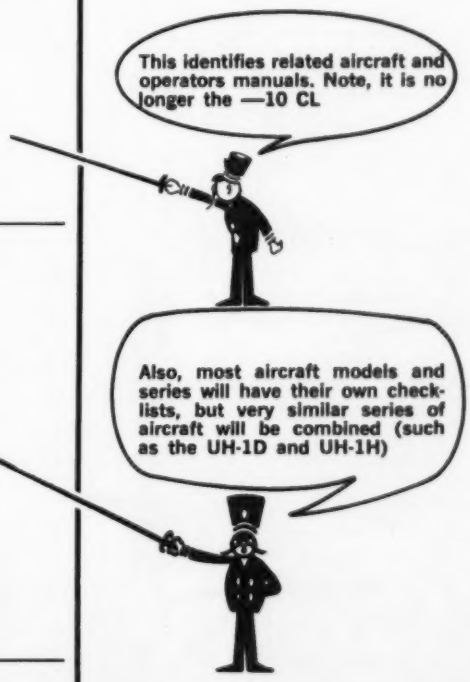
Operator's and Crewmember's Checklist

ARMY MODEL
UH-1C
HELICOPTER

Pilot's Checklist

HEADQUARTERS, DEPARTMENT OF THE ARMY

NOVEMBER 1968


This identifies related aircraft and operators manuals. Note, it is no longer the —10 CL
Also, most aircraft models and series will have their own checklists, but very similar series of aircraft will be combined (such as the UH-1D and UH-1H)

of the starred (★) steps are found in the CL for the U-21 where a detailed procedure is given following the Performance Data Section for the following checks: fuel crossfeed, boost pumps, transfer pumps, propeller automatic feathering, propeller governor checks and secondary flight idle stop check. As the checklist is designed to remind operators of a series of steps to be performed in sequence the use of the (★) allows the basic checklist to remain uncluttered.

(I) Indicates mandatory check for "instrument flights."

(O) Indicates if installed.

The pages utilized for the "General Information and Scope" establish the procedures for and encourages the reporting of errors, omissions and recommendations for improving the checklist. The user should submit his comments on DA Form 2028 direct to the Commanding General, U. S. Army Aviation Systems Command, ATTN: AMSAV-M, P. O. Box 209, St. Louis, Mo. 63166. These same comments should also be sent to the Commandant, USAAVNS, ATTN: AASDI-E, Ft. Rucker, Ala. 36360.

Figure 2 shows extracts of pages from the Normal Procedures Section of the new O-1 checklist.

The Emergency Procedures Section is outlined by alternating black and white hashmarks. (Figure 3).

The takeoff and landing data card in the Performance Data Section covers the four phases listed below as well as those items which are applicable and change during

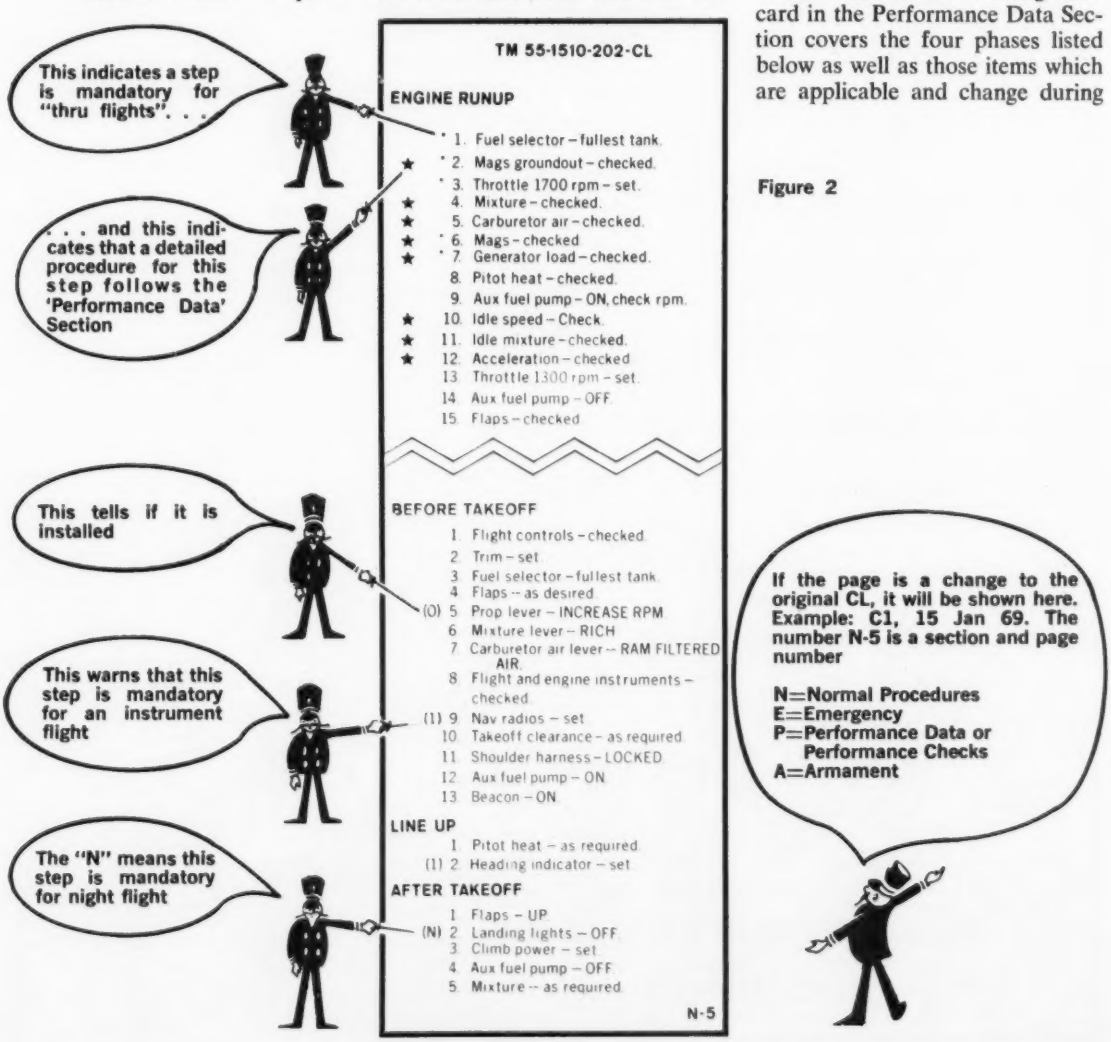

This indicates a step is mandatory for "thru flights". . .
. . . and this indicates that a detailed procedure for this step follows the 'Performance Data' Section
This tells if it is installed
This warns that this step is mandatory for an instrument flight
The "N" means this step is mandatory for night flight
TM 55-1510-202-CL
ENGINE RUNUP
* 1. Fuel selector – fullest tank.
★ * 2. Mags groundout – checked.
* 3. Throttle 1700 rpm – set.
★ 4. Mixture – checked.
★ 5. Carburetor air – checked.
★ * 6. Mags – checked.
★ * 7. Generator load – checked.
8. Pitot heat – checked.
9. Aux fuel pump – ON, check rpm.
★ 10. Idle speed – Check.
★ 11. Idle mixture – checked.
★ 12. Acceleration – checked.
13. Throttle 1300 rpm – set.
14. Aux fuel pump – OFF.
15. Flaps – checked.
BEFORE TAKEOFF
1. Flight controls – checked.
2. Trim – set.
3. Fuel selector – fullest tank.
4. Flaps – as desired.
(O) 5. Prop lever – INCREASE RPM.
6. Mixture lever – RICH.
7. Carburetor air lever – RAM FILTERED AIR.
8. Flight and engine instruments – checked.
(I) 9. Nav radios – set.
10. Takeoff clearance – as required.
11. Shoulder harness – LOCKED.
12. Aux fuel pump – ON.
13. Beacon – ON.
LINE UP
1. Pitot heat – as required.
(I) 2. Heading indicator – set.
AFTER TAKEOFF
1. Flaps – UP.
(N) 2. Landing lights – OFF.
3. Climb power – set.
4. Aux fuel pump – OFF.
5. Mixture – as required.
N-5
If the page is a change to the original CL, it will be shown here. Example: C1, 15 Jan 69. The number N-5 is a section and page number
N=Normal Procedures
E=Emergency
P=Performance Data or Performance Checks
A=Armament

Figure 2

takeoff and landing.

(1) Takeoff data
(2) Landing immediately after takeoff
(3) Landing data
(4) Conditions

The performance data card is provided as a convenience to the operator and will be filled in with the appropriate data when the local flying conditions and mission requirements warrant.

Not all aircraft CLs will have performance data charts. For example, no performance data charts will be included in the new DA CLs for the following aircraft: O-1, U-1, U-6, OH-13, TH-13T, UH-1, OH-23. These charts were removed in some cases because they did not provide required information.

Future revisions to the specifications for the preparation of performance data charts may result in the inclusion of pertinent and usable performance data charts for some of these aircraft. On the other hand, the new CH-47 CL has eight performance data charts and the CH-54 CL will have seven performance data charts. A typical performance data chart from the Performance Data Section of the new checklist for the CH-54 is shown in Figure 4.

The detailed procedures for certain steps, those indicated by a (★) in the Normal Procedures Section, follow the Performance Data Section. Figure 5 is an extract of a page from the O-1 checklist.

In addition to the detailed procedures for certain steps, checklists for certain auxiliary equipment also follow the Performance Data Section of the CL. This auxiliary equipment includes Armament Systems and such special devices as hoists. (Figure 6).

The basic document for the format of the checklist is MIL-M-63029 (TM), Military Specifications—Manuals, Technical: "Man-

TM 55-1520-220-CL

FIRE

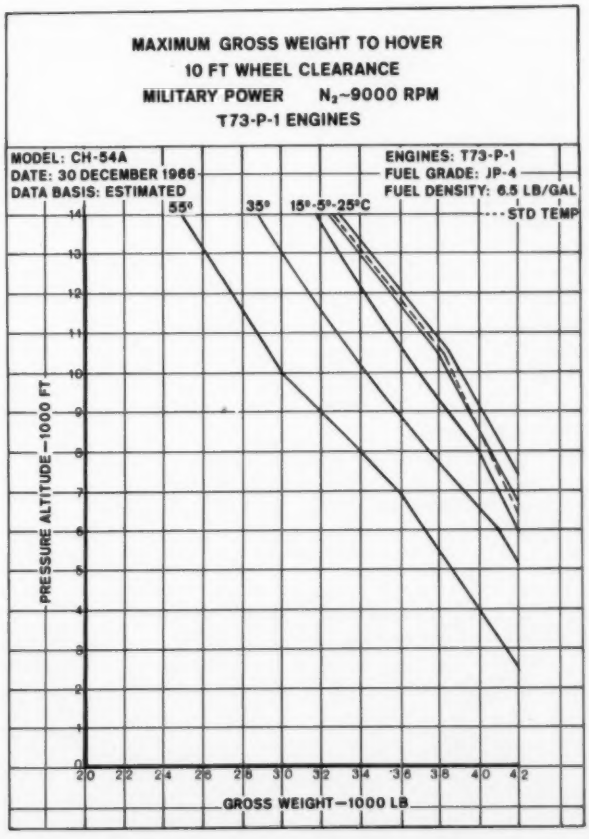
ENGINE FIRE DURING STARTING – INTERNAL

1. Starter Switch – Continue to press.
2. Throttle – Close.
3. MAIN FUEL – OFF.
4. As EGT decreases to normal – Complete shutdown and record limit and duration of hot start on DA Form 2408-13.

Figure 3

Figure 4

TM 55-1520-217-CL



uscript Requirements for Operators and Crewmembers Checklists for Aircraft." The Equipment Manual Field Office (EMFO), Letterkenny Army Depot, Pa., is responsible for the preparation of MIL-M-63029 (TM).

The U. S. Army Aviation Systems Command (USAAVSCOM), St. Louis, Mo., is responsible for the publication of all Department of the Army aircraft operators manuals and checklists.

As excellent and functional as the new checklists are, there is at least one proposal still under consideration which may be incorporated into the checklist format in future revisions. This proposal is the division of the checklists into five parts instead of three. If this proposal were adopted, future checklists would have normal procedures, emergency procedures, performance data, armament and auxiliary equipment sections.

It can readily be seen that the advancements and improvements in operators and crewmembers checklists have resulted in up-to-date, standardized user-oriented checklists throughout Army aviation. Similar changes have been taking place in operators manuals and the final article in this series will discuss the format and content of the "dash 10s" of the future.

TM 55-1510-202-CL

PERFORMANCE CHECKS

MAG GROUNDOUT

CHECK for groundout at 700 rpm.

MIXTURE CHECK

CHECK at 1700 rpm by moving mixture lever toward LEAN position. Any rise not exceeding 40 rpm is satisfactory. No rise indicates excessively lean mixture. Do not exceed 100 rpm drop during check.

CARBURETOR AIR CHECK

CHECK by moving carburetor air lever to HEAT/ALTERNATE AIR. Tachometer should indicate a noticeable drop in rpm, not to exceed 50 rpm. (On aircraft with heat filter installed, only a slight drop will be indicated.)

Figure 5

Figure 6

TM 55-1520-220-CL

M5 ARMAMENT SUBSYSTEM
OPERATOR'S CHECKLIST

EXTERIOR INSPECTION

1. Turret Assembly – SECURED
2. Top Enclosure Assembly – FASTENED
3. Forward Enclosure Assembly – FASTENED
4. Boot Assembly – FASTENED

ON ENTERING THE HELICOPTER

1. GUN POWER Toggle Switch Guard – DOWN
2. MAIN POWER Toggle Switch – OFF
3. Armament AC and DC Circuit Breakers – IN
4. Sight Assembly – STOWED
5. Ammunition – LOADED

A Controller's Dilemma

CW2 Harry E. Karnes Jr.

THERE IS A saying among tower operators that "pilots have a more distorted sense of direction, distance and time than anyone alive."

Truthfully this is not always a fact. However in far too many cases we find ourselves "guesstimating" because we feel we have to make some sort of report. In many circumstances, this can be a perplexing situation. For example, a controller has known traffic, a U-6A Beaver, (91 knots) 10 miles south for landing. A couple of minutes later, a T-42 Baron (156 knots) reports 10 south for landing. The controller must now change the sequence so he will have the Beaver following the Baron. Now guess who shows up first? You're right—the Beaver! The Beaver pilot has got his head on a swivel "eyeballing" for the Baron, the controller has to go to sick call to replace a pulled vertebra, and in the final analysis, the controller must contact the Baron, redetermine his position and re-sequence his traffic accordingly.

It's not hard to imagine the chaos a situation like this would cause if just five aviators "guesstimated" during a peak recovery period.

Another misconception that many aviators have is that the controllers or ground communicators are sitting by their radios anxiously awaiting their calls. If there is no immediate reply, they'll call a second and third time and with each call will berate the controller for not being "on the ball."

In truth, an air traffic controller's primary concern is for a safe, expeditious flow of air traffic. He must consider the overall flow of traffic and integrate other inbound and departing traffic into the existing flow. The chances that your transmissions were not monitored are very slim. There is a possibility you either cut out another aircraft making a call, or your call was cut out by another aircraft. This problem can easily be avoided by monitoring the frequency to ascertain that the frequency is clear of traffic before making a call. This is only common courtesy in any other type conversation. In almost all cases there is no necessity for a second call to the tower even though the controller might not have come right back with a reply. You must remember that he controls air traffic on several different frequencies, on three different frequency bands.

Another traffic jamming situation is caused primarily by the pilot who labors under the misapprehension that his particular aircraft is the elite of Army aviation and should be rendered all services and ceremonies due visiting dignitaries. This is the type of "bird man" who won't even report entering the traffic pattern because he firmly believes this is superfluous: he should be given the right of way . . . that's the reason there's a control tower on the field . . . to get everything out of the way. Now we all know that WE would not take this type of "holier than thou" attitude. Don't you believe it! We can all recollect the times that we've expressed criticism of the controller because he gave the "Puddle Jumper 1A" priority over our "Road Hog 37."

The system of first come, first served is the byword of the air traffic controller. This method is used generally in all cases except when it serves the best interest of the overall flow of traffic. He has the single mission of getting all aircraft on and off the ground in one piece. If this appears to be a relatively simple task, try to visualize four or five automobiles rushing to occupy the same parking place simultaneously.

The same applies to aircraft making approaches. The Army complement of aircraft is as varied as women; they all have different approach speeds. The matter of trying to place these aircraft in an alignment order and maintain the prescribed minimum separation for safety, often results in some nerve shocking experiences when this orderly flow is interrupted.

Our tower people are not infallible. They are faced with training and personnel problems the same as any other functions of the Army aviation program. However I know that they maintain a high sense of responsibility and concern not always found in other fields of endeavor.

Air traffic control personnel have but one purpose and that is to assist the aviator in his endeavors. A small amount of common courtesy is little reward for an aviator to render to one who is also dedicated to Army aviation.

Turbocharger OH-13S

This article is intended to explain the operation of the turbocharger system, its limitations, malfunctions, emergency actions, and a few points on the preflight of the system. It is hoped that it will increase pilot knowledge and decrease aircraft damage and possible injury caused by lack-of-power crashes resulting from turbocharger failure

Captain Robert B. Franklin Jr.

THE TURBOCHARGER is an exhaust-gas powered air pump. As such it has no mechanical linkage with the engine and is entirely dependent on exhaust gas pressure for operation. The amount of gas passing through the outboard, or exhaust side of the blower housing, determines the rpm of the turbocharger and, thereby, the amount of boost pressure available. The amount of gas passed through the blower is determined by the waste gate which is located in the small exhaust pipe.

Controlled mechanically by an actuator, the waste gate itself resembles the butterfly in a carburetor. The more perpendicular it is to the exhaust flow, the more the pipe is closed off, thus forcing exhaust gas into the turbocharger, where it spins the turbine, and then exits through the large exhaust pipe.

The waste gate actuator is essentially a cylinder with a spring loaded piston connected to the waste gate. The cylinder is filled with hydraulic fluid. The actuator is regulated by the density controller which, through back pressure in the hydraulic system, causes the piston to move against the spring, thus closing the waste gate.

The density controller is located between the outlet side of the blower housing and the carburetor. It is a diaphragm device that is sensitive to heat and pressure. Mounted on the diaphragm is a needle valve that opens or closes the hydraulic line running from the waste gate actuator to the supply. As a demand is put on the engine, the diaphragm expands, thus partially or wholly seating the needle valve, causing back pressure in the line and moving the piston of the actuator.

There is no air connection between the exhaust and inlet side of the blower housing. The only connection is a shaft that mounts a turbine on the exhaust side and a compressor on the inlet side. This shaft runs in bronze bushings that are cooled and lubricated by engine oil. Both the turbine and compressor are fastened securely to the shaft, providing a 1:1 ratio. Air is drawn in through the air filter and rammed into the carburetor at a boost pressure dependent on the operating rpm of the turbocharger.

Most of the system is concerned with hydraulic pressure, and any loss or partial loss of hydraulic pressure will affect the operation of the turbocharger. Listed below are the malfunctions that can occur in the system and the remedial action to be taken in each case.

• *High side failure*—compressor pressure (no. 2 needle) exceeds 39.0 inches HG.

If operation is continued with this high reading, engine failure is probable.

Remedial action: Reduce airspeed and power to allow continued flight with a reading of less than 31.4 inches HG manifold pressure (no. 1 needle). A running landing may be necessary to prevent an overboost caused by termination of an approach to a hover.

• *Low side failure*—manifold pressure (no. 1 needle) and compressor pressure (no. 2 needle) join.

When this occurs the turbocharger has failed and engine power is reduced to that of a normally aspirated engine.

Remedial action: Reduce airspeed and increase power to maintain safe flight. Maximum power available will be in the neighborhood of 28 inches HG manifold pressure. This will allow continued flight at a reduced airspeed; however, there will not be enough power for hovering flight. Therefore, all approaches should be made using a shallow approach angle and should be terminated with a running landing. It should be kept in mind that with a loaded ship it will be impossible to take off again except under ideal conditions, i.e., 15 knots of wind and a smooth surface for a running takeoff.

• *Loss of hydraulic pressure.*

If hydraulic pressure is lost in the waste gate actuator system, the actuator will move to the full open position causing reduction in power available equal to that of a normally aspirated engine. If hydraulic pressure is lost outside of the waste gate actuator system both a check valve and the Ronson valve close, maintaining a pressure of 40 psi in the actuator system. This may allow the waste gate to remain in the trim position. (The trim position is that position the waste gate was in when hydraulic pressure was lost.) Therefore, if hydraulic pressure was lost under a high power setting, it is possible that boost pressure will still be available. If the pressure was lost during a low power setting, minimal boost, if any, will be available. Caution: When hydraulic pressure has been lost and the pilot feels that the waste gate is in the trim position and the blower is providing boost, he should be prepared for a total loss of boost at any time.

Remedial action: For either of the above conditions, the pilot should use the same technique as with a low side failure.

It is also possible to have a partial loss of power due to a hole in the exhaust system, a loose exhaust pipe, a hydraulic leak or a frozen pin in the waste gate arm. In most cases, the power loss will not be large and will only cause a slight loss in usable power. In all cases where a loss of rpm and power is experienced, lower the pitch, flare the aircraft and roll on throttle to maintain power for flight.

If the cause of loss of power is a turbocharger malfunction or failure, flight can be continued by reducing airspeed. If power and rpm cannot be maintained with pitch lowered and aircraft in a flare, then, and only then, execute a forced landing. Remember: If you are flying low level, give the engine a chance to regain rpm. If you have altitude, you have plenty of time to determine the cause of the power loss and whether or not continued flight is possible.

There has been a recent rash of turbocharger failures. It is felt that the majority of these failures were directly attributable to improper shutdown procedures. The proper shutdown procedure is as follows:

The engine must be idled at 2200 to 2300 rpm for 4 to 5 minutes before shutdown to prevent oil coking on the bearing surfaces within the turbocharger housing. Oil, such as used in the engine, cokes at a temperature of approximately 670 degrees F. If the engine is shut down while the bearing temperature is still above 670 degrees F, the oil that has now become stationary in the bearings, will form a layer of coke between the bearings and the turbocharger shaft. This layer of coke will produce friction on the shaft reducing the effectiveness of the turbocharger. If enough coke forms within the bearings, it will prohibit rotation of the shaft and cause complete turbocharger failure.

An adequate cool-down period is necessary to insure continued operation of the turbocharger. The 4 to 5 minute cool-down period will generally insure adequate cooling; however, an engine cylinder head temperature reading of 150 degrees C must also be obtained before shutdown. Do not substitute 150 degrees for the 4 to 5 minute period, but rather it is an additional requirement.

Another cause of blower failure has been inadequate preflight and daily inspections. A prerequisite to proper operation of the turbocharger system is that the system be airtight. If there is a leak that permits exhaust gases to escape, it will deprive the blower of that much pressure, reducing blower rpm and consequently available boost. The inspection should insure that the system is tight, the clamps are securely fastened, drain plugs are secure and safetied, and that no holes or cracks are in the system. A check should be made of the hydraulic system to insure that there are no leaks.

A final check is to insure that the pin that connects the waste gate actuator to the waste gate arm is safetied, yet is free to move up and down. If it is tight and hard to move, the system will bind, causing sluggishness of response and possible immobility of the waste gate.

As pilots, we should insure that the system is operated within its design limitations. The system is designed to be operated continuously at manifold pressures up to 31.4 inches HG. Manifold pressures over 33.4 inches HG and up to 270 hp can be maintained for up to 2 minutes. At no time should the compressor pressure exceed 39.0 inches HG. Continuous overboosting of the engine will drastically reduce engine life and will cause engine failures. This can be embarrassing and fatal.

Steep Angle Instrument Approaches

Captain John A. Geurin

The helicopter must be afforded a means to approach and land at a site restricted in size and also to instrument conditions

AS A RESULT of the increasing buildup of the helicopter's mission in the Republic of Vietnam, the requirement for further developing the helicopter's all-weather capability has become vividly evident. Until a satisfactory means is developed to enable the helicopter to approach and land at a site restricted in size and means of access under instrument flight conditions the helicopter can never completely fulfill its tactical potential.

Helicopter missions normally are short trips, conducted in restricted areas, flown at low altitudes, requiring numerous landings and diversions to alternate destinations.

In considering these characteristics it was felt an investigation of a steep angle precision approach capability would be a significant step in the evaluation of helicopter instrument operations. Past research projects have identified through theoretical and flight evaluation the specific performance capabilities which should determine the distinctive pattern if the helicopter is to operate as an all-weather vehicle. Two basic characteristics, *slow speed and exceptional maneuverability under visual conditions,* should be reflected in standards for helicopter instrument operations in contrast to those appropriate to fixed wing aircraft, especially in the tactical environment.

An aircraft approach procedure, whether executed visually or under instrument conditions, should reflect man-machine capability. In fixed wing aircraft the pilot techniques involved in a visual approach as compared with an instrument approach normally differ only in the degree of precision required. Helicopters descend under visual conditions at approximately a 12 degree angle. However on instrument flights helicopters fly approach procedures, designed for fixed wing aircraft, with a maximum approach angle of approximately 3 degrees.

The need to make the instrument approach procedure compatible with helicopter performance characteristics becomes increasingly apparent as the operational patterns of fixed and rotary wing aircraft grow more divergent. From a tactical standpoint a steep approach from enroute flight under instrument conditions means less exposure to ground fire during the descent and a greater flexibility in the selection of tactical landing sites. For civil operations the use of steeper slopes can provide one of several possible solutions for the separation of fixed wing and rotary wing aircraft approach paths and for greater access to heliports under instrument flight rules.

Several research projects have evaluated steep angle approaches under simulated IFR conditions to determine maximum flyable angles for helicopters. However such tests generally have been conducted by engineering test pilots in aircraft equipped with experimental equipment. No evaluation has been made with sufficient sampling of operational pilots and present Army inventory aircraft types to indicate the steep angle capabilities of pilots and helicopters currently operating under IFR conditions.

NASA Test: NASA initiated a test program to investigate some of the basic problems of steep angle helicopter instrument approaches wherein the focus was on angles substantially higher than the normal fixed wing approach path angle. Included in the areas of interest were displays, piloting techniques and the effects of the use of different glide angles, rates of descent and airspeeds.

The helicopter used was an HRS (S-51), equipped with standard ILS as well as VOR receivers. Lateral guidance for the test flights was derived from both these sources at different times. The helicopter had no automatic stabilization or stability augmentation equipment.

The principal glide angles flown were 6, 9 and 12 degrees. It seems surprising at first that with a system capable of providing any glide slope up to and including 90 degrees, NASA should limit the larger part of the testing to angles of 12 degrees or less, but earlier tests by NASA at Langley Field showed that these higher angles present a host of difficulties due primarily to the low forward speed associated with a safe rate of descent on very steep angles.

During the test a speed of 25 knots was found to be the lowest practical airspeed for adequate aerodynamic behavior and control for the test helicopter. The general level of difficulty in helicopter instrument flying has been found to increase as speed is reduced. At higher airspeeds steep approach paths result in increasingly higher rates of descent that are undesirable if they exceed 500 to 700 ft/min. As power is reduced to achieve a steep path with constant airspeed, autorotation may be approached making it almost impossible to correct downward to a desired path when high. These factors limited the glide angle in most tests to 12 degrees for the airspeeds tested which were 30, 45 and 60 knots. Even 12-degree slopes required a headwind in the opinion of the test engineer.

This project was conducted jointly by the U. S. Army and the FAA to evaluate steep angle precision instrument approaches compatible with man-machine capabilities to be expected operationally.

Testing was conducted at three tactical GCA sites in the Ft. Rucker, Ala., area. Data was collected on 268 simulated GCA approaches flown by Army helicopter pilots and project team pilots in the TH-

Steep Angle Instrument Approaches

Some tests were conducted at tactical GCA sites at Ft. Rucker

13T, UH-1 and CH-47 aircraft. Though project objectives were necessarily oriented to military equipment and tactical requirements, the data also can be evaluated for application to civil procedures development and common system approach facilities. The following factors were considered:

- The flyability of steep angle approaches
- Airspeed/vertical velocity envelopes
- Deceleration distances and exposure time
- Decision heights
- Required obstruction clearances

Testing Methods: The general plan was to observe and record ground radar controlled approaches, executed at pre-selected airspeeds and approach angles under varying conditions of wind and aircraft weight. The aircraft flown were representative of types used for military instrument training and tactical operation. A preselected number of approaches were flown with loads up to maximum allowable gross weight. Pilot proficiency and experience ranged from that of pilots at the 150-hour level of flight training to instrument rated aviators of the Advanced Instrument Division.

The majority of approaches were flown to a tactical site chosen to permit theodolite tracking of approaches from at least two directions within the range of glide slope angles to be used. An additional tactical site was selected in order to compare the accuracies of coarser settings at the two sites. Marker stakes were at 50-foot intervals inbound from the touchdown reflectors for measurement of deceleration times and distances.

The minimum airspeed selected was 30 knots. Below this speed, helicopter control under hooded or instrument conditions becomes progressively more difficult and less predictable. Maximum speed tested was 70 knots, commonly used during visual approaches in the UH-1 and CH-47. At the highest angle tested (15 degrees), 70 knots would require a rate of descent in excess of 1,650 ft/min under zero wind conditions.

Testing began with an airspeed of 70 knots and slope set at 15 degrees. On successive approaches, the airspeed was reduced by 10-knot increments until the angle was rejected as unflyable because of difficulty with control of airspeed, vertical velocity or power. The glide slope angle was then reduced by one degree increments until a maximum flyable angle/airspeed combination was found. Data collection runs were continued at this angle and at three lower angles.

The instrument approach pattern was established by radar fixes at 2, 3 and 4 miles from the Ground Point Intercept (touchdown reflector) to define the length of Intermediate and Final Approach segments. All approaches were conducted with standard controller techniques.

Each approach was tracked by theodolite from the Intermediate Fix inbound. Azimuth positions with respect to the Final Approach course were recorded at one-quarter-mile intervals called by the GCA controller. Twelve data collection points were established between the three mile Intermediate Fix and a point one-quarter mile from the touchdown reflector. Excursions of the aircraft from glide path were observed by theodolite and recorded from glide path intercept at 2 NM to the one-quarter mile point. Eight data collection points were established for observation of each descent.

Data Acquisition: Theodolite positions were established at two points on runway 7 and 27 centerlines directly opposite the touchdown reflectors. With exact alignment of the theodolite on these approach courses and glide slopes, no parallax error was introduced into theodolite data. The accuracy of the radar glide slope and course alignment was established by flight check and by correlation of recorded controller calls and radar scope photographs with the theodolite observations. The photos and recordings were used to assess the accuracy of the slope settings and the controller's techniques in calling position and directing corrections to the flight path.

Exposure time from Decision

Height to touchdown and deceleration distances for the varied angles of descent also were recorded. Deceleration time was clocked by the pilot on each approach, beginning when the aircraft reached the Decision Height for assumed 100 foot ceiling minimum and ending at the Approach Termination Point (zero ground speed hover). Deceleration distance was measured from the touchdown marker to ATP and recorded. Total deceleration distance for each approach was the sum of the measured deceleration distance (D) plus the computed horizontal distance (D_1) from decision height to the touchdown marker. (See Figure 1).

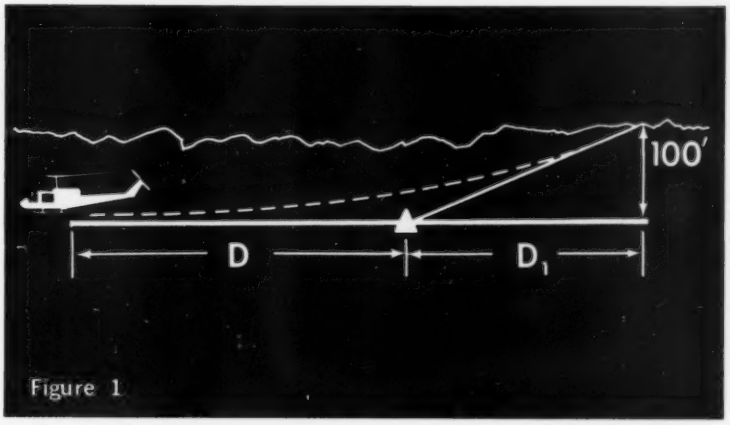


Figure 1

The field data was first edited to remove runs which contained too few data points to be useful. Wind data were then applied to the recorded indicated airspeeds to compute the effective slope flown on each run, using the formula:

$$\text{Effective Angle} = \frac{\text{Groundspeed}}{\text{True Airspeed}} \times \text{Set Angle}$$

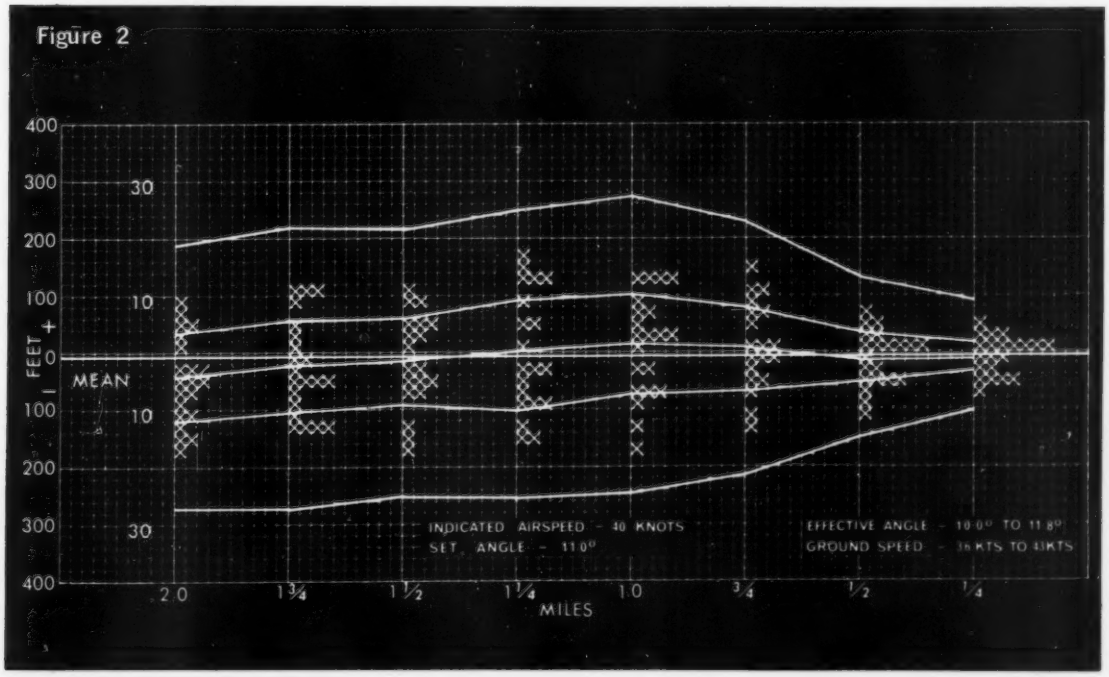
Effective angles were then grouped within a plus or minus 5 knots of indicated airspeed.

All theodolite angles were converted to their equivalent in feet for each one-quarter mile interval. Histograms then were plotted for dispersions from the actual radar glide slope as measured. From these histograms statistical calculations for the mean and standard deviations were made and plotted on the same charts with the histograms.

Course tracking data were grouped according to indicated airspeed only without regard to angle flown. Histograms of the course dispersions were plotted and calculations of the mean and standard deviations made for each.

The tightest grouping of glide path data appears in Figure 2. On these approaches, the average in-

Figure 2



Steep Angle Instrument Approaches

dicated airspeed was 40 knots, set angle 11 degrees, effective angle range from 10.0 degrees to 11.8 degrees and an average ground speed of 40 knots. At the one-quarter mile data point all aircraft were within 60 feet of the glide path. At the same indicated airspeed but at higher effective angles and ground speeds the excursions increased above and below glide path. At these higher angles and ground speeds more scattering is shown and more aircraft are above path at the one-quarter mile point.

At 30 knots IAS and an average effective angle of 12 degrees the mean flight track at the 2 mile data point is approximately 80 feet above glide path and remains high through the one-quarter mile point. Problems in aircraft control are evident from the scattering of data. Exceptional proficiency is required to coordinate power and attitude control at 30 knots on a 12 degree path with standard instrument presentation. Pitch interpretation and control become increasingly difficult at 30 knots and below. Over-controlling commonly is the result and the instability is reflected in exaggerated attitude changes and erratic instrument indications. At 30 knots strong crosswinds, turbulence and wind sheer during the last half-mile of the approaches aggravated the problem of aircraft control.

With reference to the mean path flown and the one standard deviation limit shown, the precision shown at 50 knots IAS is slightly less than on the approaches flown at 40 knots with approximately the same average effective angle.

The greater dispersions shown for the 50 knots data may be attributed to the higher rates of descent required resulting in faster departures from glide path and problems with power control.

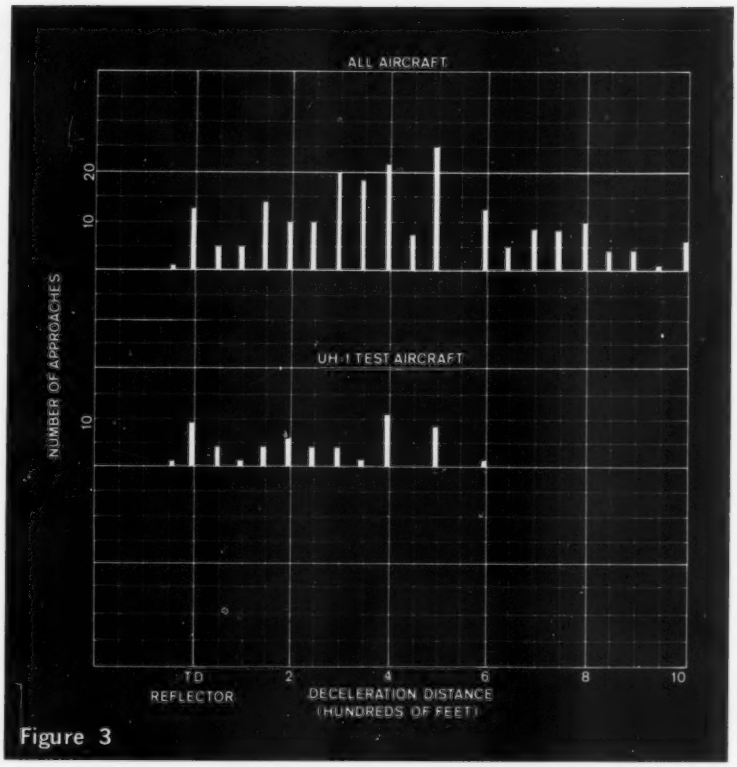


Figure 3

Deceleration time/distance data recorded on 222 approaches was edited to remove those recorded as not flyable. In these instances the aircraft overshot the glide path and remained high throughout the approach. Figure 3 includes the deceleration distances for all the aircraft types flown, with no breakdown according to speed or weight. The difference could not be related to speed or weight and may be a result of pilot technique.

Computation of obstruction clearance requirements was adapted from the method used or standard ILS approach. The ROC is predicated on the statistics for set angles from 8 to 11.5 degrees and ILS from 40 to 60 knots.

The three sigma value (99.7 percent probability) was plotted at each one-quarter mile data point and the slope computed using the point which measured the maximum below path. The average of all five slopes was then averaged for all angles and airspeeds. The rounded off value of 2.25 degrees can be applied in the following formula to determine the glide slope angle that will provide a three sigma obstruction clearance for a given critical obstruction in the approach area.

$$GSA = OH + 60' \ 17.45 \times D + 2.25°$$

OH—obstruction height above GPI

D—obstruction distance in thousands of feet from the GPI

Course deviation statistics were used to determine the lateral area required for obstruction clearance. This was computed using 40, 50 and 60 knot approaches at all angles and is an area 250 feet wide at the GPI, expanding uniformly to 8,000 feet wide, 25,000 feet out from the GPI.

Conclusions: Analysis of glide

path data supports a minimum airspeed of 40 knots and a maximum effective slope of 12 degrees. Pilot opinion gained from questionnaires indicated 1,200 ft/min as an acceptable maximum rate of descent for approaches to a Decision Height of 100 feet with one-quarter mile visibility. Because of known preconceptions existing among the pilots in the test as to the flyability of steep angles they were not told what angles were set. On many approaches pilots with a stated aversion to instrument approaches above conventional three-degree angles commented favorably on approaches they assumed to be lower.

With sufficient time factors and other determinants of precision altitude control a pilot should be able to fly instrument approaches up to the highest usable angle for his aircraft. If wind conditions at a particular site are causing an effective angle of more than 12 degrees the approach direction can be changed in approximately seven minutes with no loss of accuracy.

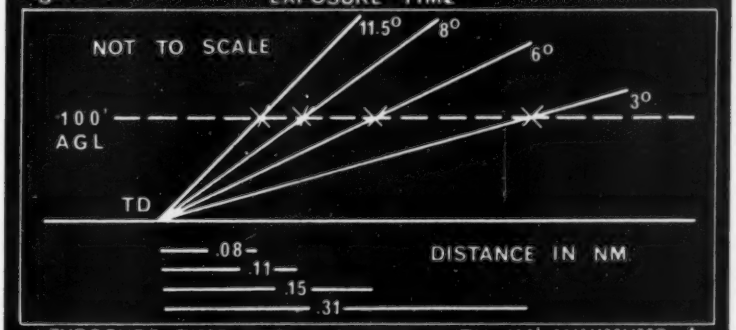
The time interval between breakout from instrument conditions to completion of the approach by visual references to the ground is significant in the light of exposure to ground fire.

Figure 4 indicates exposure times for various angles and ground speeds with an assumed ceiling of 100 feet, 1,000 feet and 1,500 feet AGL. With 100 foot ceiling the difference in exposure time between three and 11.5 degrees is very small. However with a higher ceiling the tactical advantage to the steep angle is clearly evident.

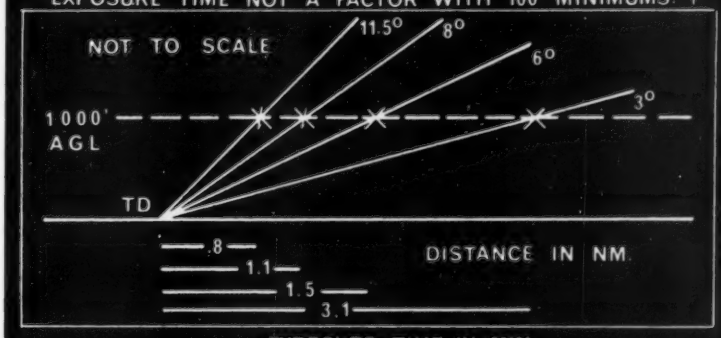
Assuming a minimum ceiling to 100 feet and a maximum effective glide path of 12 degrees any of the helicopters tested during this project should be capable of completing the approach to an ATP (Approach Termination Point) 600 feet past the Ground Point of Intercept (touchdown marker).

Figure 4

EXPOSURE TIME

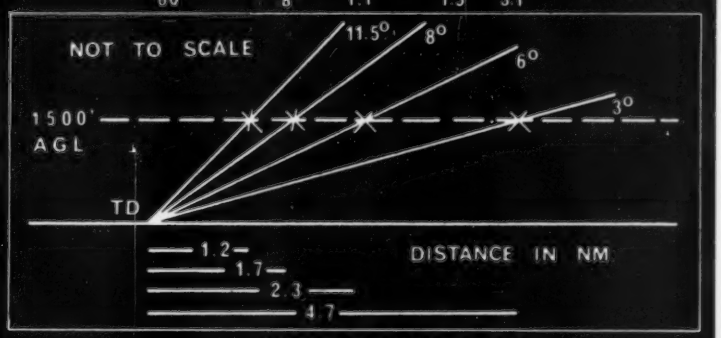


EXPOSURE TIME NOT A FACTOR WITH 100' MINIMUMS.



EXPOSURE TIME IN MIN.

	11.5°	8°	6°	3°
40 KTS	12	1.6	2.5	4.6
50	9	1.3	1.8	3.7
60	8	1.1	1.5	3.1



EXPOSURE TIME IN MIN.

	11.5°	8°	6°	3°
40 KTS	1.8	2.6	3.5	7.0
50	1.4	2.2	2.7	5.6
60	1.2	1.7	2.3	4.7

An instrument approach procedure, whether executed visually or under instrument conditions, should reflect the man-machine capability. The need to make the instrument approach procedure compatible with helicopter performance characteristics becomes increasingly apparent as the tactical requirements of rotary wing aircraft continue to increase.

Your Own Worst Enemy:

YOU!

Lieutenant Terry L. Dyke

Your preflight—how well you inspect your aircraft before strapping in and starting up—can slip to a point where it becomes automatic . . . deadly automatic

AS AN AVIATOR flying in Vietnam it is easy to identify "the" greatest hazard of flying. We can say crowded airspace, artillery rounds, high performance jets or any other good, sound hazards.

Certainly all of these take their toll. However, one that's not often listed is, in my opinion, the greatest single hazard of all—the Army Aviator. He is his own worst enemy who becomes more so with every hour he flies.

Since it has been my mission to fly an O-1D in Vietnam, the statistics regarding it are the ones with which I'm most familiar. More than 60 percent of the Bird Dog mishaps in Vietnam are attributed to pilot error which is usually combined with complacency and overconfidence. Often the aviators involved have over 500 hours in the O-1.

When one does something day in and out, such as dress himself or shave or lace his boots, he does it out of habit. It's a routine—a ritual which needs no rehearsal, or forethought. So, the preflight can also become a habit to the aviator who flies four to five hours daily in Vietnam. The preflight, the vital airplane inspection before strapping in and starting up, can slip to the point of the instinctive and automatic . . . and deadly.

There is a valid case for memorizing preflight procedures. The act, through practice, becomes ingrained on the brain and is something the aviator is not apt to forget. But this practice establishes an animal pattern. Soon the aviator is no longer logically thinking through the process, but instead is obeying his instincts to check this and that, in A-B-C order. Though thorough, it is a mindless approach. Break the routine somewhere and it could mean trouble. My personal case is most demonstrative.

On 6 April 1968, I was flying my O-1 on a reconnaissance mission

over treacherous terrain around Dak To. Upon landing at the airstrip for fuel, oil and a quick lunch, I noticed oil streaked on the fuselage and spattered on the windshield. After refueling, I began my preflight of the aircraft while the aerial observer went for oil. The dipstick registered 1½ quarts low. During the engine check I took great pains to locate the source of the oil seepage. I found it dripping from the bottom of the oil sump. I traced this oil up to the dipstick holder but the dipstick had been in tight.

Still dissatisfied I examined the engine carefully for other possibilities, while the observer added more oil to the crankcase. With all of this inspection, I missed the forest for the trees. I'd broken my preflight routine and had failed to check the oil cap for security! With all the extras, I'd forgotten to do the basics. I closed the cowling, and we got in and took off.

From there, my fate was sealed. After 20 minutes of flight I noticed oil coming in through the floor around the left rudder pedal. I turned toward Dak To, thinking at first it was the oil seep I'd found on the ground turning into a dangerous leak. My eye caught the oil pressure gauge which had now dropped to zero. Either the leak was terribly serious or the oil cap was off! Then in my disbelief I knew what it had to be—the oil cap. And I wouldn't make it to Dak To. I quickly settled on Ben Het, a Special Forces camp 15 miles west of Dak To. After shutting down at Ben Het, a quick look at the plane revealed the awful truth. The cap was dangling and only 1½ quarters remained in the oil sump. Also, the oil screen revealed a quantity of metal particles and the engine was cooked—it would have to be replaced.

I was lucky—darned lucky. A few minutes more and the engine would have "frozen up." We could have lost the aircraft and even the crew in the vicious mountain jungle. My automatic preflight routine had been broken and now so was an engine.

When an aviator flies infrequently or is new to an aircraft, he is acutely aware that he may make a mistake. Consequently he uses his checklist on preflight. But the checklist also has its place with the man who has a lot of time in the aircraft. It should be among the items he considers as important as his flight gear. A pouch, slot or map case in the aircraft cabin should contain an up-to-date checklist. The seasoned aviator should always compare his preflight inspection with his checklist. Did he miss anything? Did his procedures deviate from what is written?

During preflight and runup, the aviator must constantly be aware of the reason behind each check he makes. He must think about the things that can go wrong with each part, item or system he is checking. He must assume that everything about the plane is wrong, broken, out of place, or missing, and he must therefore insure that these conditions do not exist before accepting the ship as flyable.

The aviator must constantly thirst for knowledge about his craft, with the understanding that he'll never be the supreme expert of the airplane. A review of the "dash 10" operators manual from time to time will always yield a bit of wisdom or clarify misinterpretations.

Don't let complacency lead you to think that you've given your worst enemy the slip

Dawn Recon

IN THE LATE afternoon a pin was placed on a map in the office of the G-2, 1st Cavalry Division (Airmobile). A reputable report from a Vietnamese civilian that a fresh North Vietnamese Army (NVA) Battalion was only 15 kilometers from the resettlement village of Phu My was a cause for concern.

The mission to locate the NVA Battalion was given to the division Aerial Surveillance and Target Acquisition (ASTA) Platoon. ASTA Platoon's six OV-1 Mohawk aircraft would conduct round the clock surveillance until evidence of the enemy was found.

The "Hawk" pilot scheduled for the first of the continuing surveillance missions, broke ground at 2002 hours and headed northeast. His mission was to conduct an infrared (IR) search for North Vietnamese cooking fires as they cooked their rice for their evening meal. Afraid to risk the smoke being spotted in the daytime, they would chance small fires at night under the concealment of the thick jungle canopy. As he turned north from the village of Hoi Son, he could only see a blanket of total darkness covering the rugged mountains ahead of him.

Late that night the assistant G-2 on duty was told that IR Surveillance had detected a large number of small cooking fires. The center of mass of the fires was at coordinates BR820730, only 10 kilometers from what now appeared to be the objective, Phu My. In the early hours of the morning a decision was made to have elements of the Air Cavalry Squadron conduct an area reconnaissance in the mountains 10 kilometers northwest of Phu My. At the same time the commander of the Second Brigade was alerted to be prepared for action in that area.

A Scout team, a lead ship and a chase, was scheduled to depart at 0545 for a dawn recon. They would be sent to the suspected NVA location for a detailed reconnaissance.

After a quick breakfast the observers went to the aircraft to prepare for the mission. While the pilots were being briefed the observers checked the M-2 gun kits on the two OH-13s which were the mounts that modern cavalry would use this morning to take its scouts to gather timely information. They also checked the operation of the M-60 machineguns and made sure they had fragmentation and white phosphorous grenades aboard and a few colored smoke

Captain Walter L. Duckworth Jr.

A scout team, a lead and a chase ship, was scheduled to depart at 0545 for a first light recon of a suspected NVA location

Dawn Recon

grenades to be used for marking. In the front of the bubble were two C-ration meals, just in case it was a long active day of "refuel, rearm and return." Also in the front of the bubble were 200 rounds of linked 7.62 mm ammunition which was never used unless the aircraft went down in hostile territory.

At 0546 the two OH-13s pulled pitch for the dawn recon. The lead pilot dropped his aircraft down to treetop level while the pilot of the chase ship climbed to 2,000 feet indicated, 1,500 feet absolute. The lead ship would fly contour with both pilot and observer searching the ground for any signs of enemy activity. The chase ship above would keep the lead located on the map, maintain communication with troop operations, maintain a search outside the visual range of the lead and always be in position to render covering fire for the lead ship.

As the lead pilot entered the area of search, he pulled every available knot of airspeed from his ship and eased it closer to the treetops until the skids were about 10 feet above the jungle canopy. He then began what seemed an aimless wandering about the four by four kilometer area of interest. This was to avoid setting up a predictable pattern of search. The speed while on the treetops would give the absolute minimum exposure time to hostile ground fire. If the enemy did fire, he had accomplished his mission—find the enemy. The chase pilot gave him a call on the UHF air-to-air frequency when he reached the edge of the area and he corrected his flight path accordingly. The NVA did not fire today—they had learned, the hard way, that to fire on the small bubble helicopter was to invite disaster.

Three areas were sighted which would warrant a very thorough check. As the lead pilot approached the first area, an exposed stream bed, he slowed to 60 knots. The stream had been crossed recently. As he hovered over the ford, he saw that the stream had been freshly muddied. Entering and departing the ford were fresh footprints no more than a few minutes old; the water dragged up by wet feet was still running back to the stream. The footprints told much more. They were mixed prints of old tire and innertube constructed "Ho Chi Minh" sandals and prints of the recently introduced jungle boots issued by the People's Army of Vietnam (NVA). All indications were that 15 to 20 NVA had crossed within the last 15 minutes. The observer threw a white phosphorous grenade to mark the location.

As he hovered over the ford, he saw that the bottom of the stream bed was freshly muddied. There were numerous fresh footprints on both banks of the stream

Within three minutes of spotting the footprints, a report was made to headquarters.

The lead ship's pilot started to hover above a freshly used trail leading from the ford in the general direction of Phu My. He knew that gunships were being put on alert and the aero-rifle platoon (Blues) was standing by the lift ships, some with their half eaten breakfast on paper plates, ready to go at his call.

As he moved to the southwest along the trail, he heard the calm voice of the observer say "Do a one-eighty."

As the pedal turn was executed the observer said, "There's a man on the east side of the trail. See his foot?" The pilot saw the shine of a foot not quite pulled into the underbrush, the air was shattered by the staccato crack of bullets passing near the aircraft. The weapon fired from the ground was an AK-47, standard issue of the North Vietnamese. Instantly skid guns and door gun were firing and a white phosphorous grenade dropped as the small observation helicopter broke left after the firing run. He had not had the enemy rifleman in sight; but experience had taught him that when you shoot, the enemy gets his head down.

As he climbed out he knew that the chase pilot was beginning a gun run on the area near the white pillar of smoke rising from the ground. He called operations on the FM radio and very briefly told them "Receiving fire, launch Blue." His next task was to contain the enemy near the tentative landing zone he had already selected. This could be accomplished by fire from the two scout ships and by artillery which would be used to prep the LZ.

Within five minutes after the report of contact, the troop commander was airborne with a team of two UH-1C gunships and five UH-1D lift ships loaded with Blues.

While the chase pilot was adjusting artillery fire near the proposed LZ, the pilot in the lead ship was continuing the search for other NVA in the area. On the trail northwest of the site now under fire by the artillery, the observer spotted approximately 10 more enemy soldiers running down a trail and opened fire with his machinegun. All but one of the troops disappeared into the heavy foliage on both sides of the small path. Apparently the main body of the NVA battalion was broken into small groups for movement toward Phu My.

As the troop commander approched the area of contact, he

was briefed on the situation and on the tentative two ship LZ which was now receiving preparatory fire. He was told by the lead pilot that another part of the larger unit for which they were searching was thought to have been found. The commander called for another scout team to be sent into the area.

When the lift ships, with Blues mounted, were one minute out of the LZ the artillery was stopped. The UH-1C gunships now took up the fire and led the first two lift ships into the LZ as the Blues stood on the skids of the helicopters ready to jump, even before the aircraft touched the ground.

Within one minute the Blue platoon leader had his platoon consolidated in the LZ and moving in the direction of the platoon contact. The platoon leader, platoon sergeant and all squad leaders had monitored the situation to this point over headsets tied into the aircraft radios and there was no delay or confusion once they were on the ground.

As the lift ships returned to stand by with the Ready Reaction Force (RRF), Small Chime Six, the rifle company commander, was alerted to be ready to go at a moment's notice. If a fight was started that the Blue platoon and the RRF platoon could not handle, the remainder of his rifle company would be used to reinforce.

At the same time, the Blue platoon was moving closer to the fight. The second team of scouts, White 11 and White 12, were now on station and were screening flanks and rear of the Blues. Charger Six, the Air Cav troop commander, was reconning forward of the aero-rifle platoon while his chase, Red 26, stayed to the rear, ready to engage any target found by the others with his rockets and miniguns. The scouts were also to engage targets of opportunity with skid mounted machineguns and door guns.

The Blues' point man moved down the trail; all senses alert for any sound, movement, or smell foreign to the rain forest. His hand was raised and the Blues stopped in their tracks. He dropped to one knee and confirmed his initial findings of blood on the trail. Ahead were several sets of footprints and blood spots on the ground.

He raised his hand once more then yelled, "Get down!" just as the NVA opened fire from their well concealed fighting bunkers. There was no hesitation to his command and there were no casualties from the initial burst of fire. He moved back to the main body, crawling backward while firing his M-16. When he rejoined the platoon a smoke grenade was thrown forward of their position and Red 26 began a rocket run. The rockets exploded around the NVA positions as the platoon deployed to put maximum fire on them.

The enemy panicked, broke and ran under the withering fire. Three did not make it. The remaining 15 North Vietnamese moved across the small stream toward their company, which preceded the larger battalion size unit.

Charger Six decided to place blocking fires to stop the NVA withdrawal. Then he saw more NVA through breaks in the canopy. This was the unit moving toward Phu My. He called for the RRF to be launched immediately and the remainder of the Small Chime element to be moved in by helicopters of an assault helicopter company. The RRF would join the Blues and Small Chime (-) would be inserted to the west. Blocking fires would be placed to the north and scouts and guns would screen the east where the jungle joined abandoned rice paddies, a wide open area.

These plans were discussed with the battalion commander whose battalion might be required in the coming fight, and with the brigade commander in whose area of operation the battle would occur.

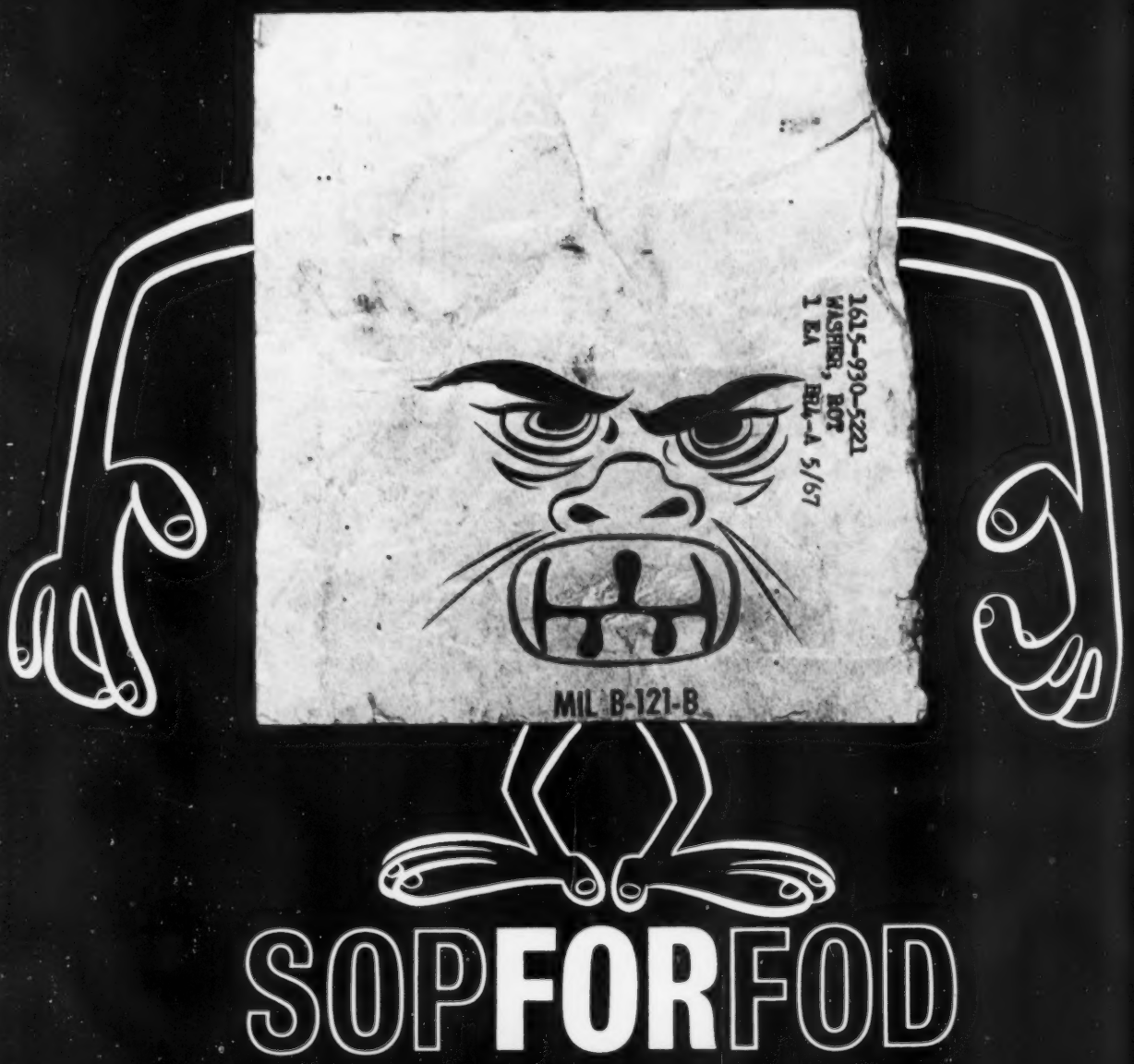
The time was now 0645 and the scout team was finding more evidence forward of the Blues. This area was indeed the location of one, maybe even two, North Vietnamese battalions. They were now told to make a thorough recon to the west to determine if any elements of the enemy task force were in that area. If Small Chime (-) was inserted in the middle of the NVA unit nothing would be gained. With only one hour left on station, they would still be able to check a large area adequately.

The RRF was inserted without incident, but one of the lift ships received ground fire after departure. The platoon moved down the trail to join the Blue Platoon now in pursuit of the enemy.

With Small Chime (-) enroute to be inserted to the west, blocking fires to the north and good gunship coverage of the rice paddies to the east, Charger Six decided to recommend that troops be placed along the eastern flank. The two commanders agreed.

As soon as all elements were in place, U. S. Air Force fighter-bombers would be used to saturate the area. The blocking artillery fires would be checked only to allow the fighters to make their bomb runs. The enemy would be forced to die under bombs and artillery or move out of the fire into the waiting American troops. After the saturation bombing, a thorough sweep of the area would be made to finish off the trapped enemy. Before the end of the day, North Vietnam would lose one of her elite battalions and the village of Phu My would be spared.

The scout team was low on fuel. Departing the area of contact the lead ship pilot relaxed a bit and decided that today's dawn recon had turned out pretty well.



SOPFORFOD

the following 28 pages prepared by the U. S. Army Board for Aviation Accident Research

After thrust washer from this envelope was used during PE, the envelope was left on the engine deck

LETTER FROM PARENT UNIT to subordinate unit commanders: "Subject: Prevention of FOD to T-53 Engines. 1. Effective immediately upon receipt of this letter, units using T-53 engines will require a daily inspection of the particle separator and plenum chamber by either the pilot or copilot of the first flight of each day. The following procedures will be incorporated into each unit's operating procedures:

"a. During the crewchief's daily preparation for a flight, he will open the cowling, remove the air filters and remove the top half of the particle separator for inspection.

"b. The pilot or copilot of the first intended flight of each day will personally inspect the particle separator and plenum chamber for foreign objects. The following daily entry will be placed in DA Form 2408-13: 'Pilots daily inspection particle separator and plenum chamber for foreign objects.'

"2. Commanders at all levels are reminded of their responsibility to provide the maximum number of aircraft on a daily basis to support mission requirements. . . . A marked improvement in availability has been shown by those units exhibiting an interest in keeping their areas clean."

UH-1C pilot: "A technical inspector, the crewchief and I were assigned to perform the necessary maintenance to correct a 1:1 lateral vibration that had been written up by the maintenance officer the previous afternoon after a maintenance test flight following a periodic inspection.

"I preflighted in a normal manner, to include checking the particle separator for accountability of Dzus fasteners and proper installation. I started the aircraft and, since the main rotor blades were being checked for proper track, I ran the engine for approximately 10 minutes, making several power changes. When the tracking check was completed, I shut the aircraft down.

"To find out how severe the vibration was, required a maintenance operational check flight. I was flying in the right seat, the technical inspector was in the left seat and the crewchief was in the cargo compartment.

"I started and made the runup with no indication of engine trouble. I called the tower for takeoff instructions, received clearance for a south takeoff, cleared my aircraft and hovered out of the revetment. As the tail cleared the revetment, I glanced at the torque gauge which indicated 35 psi and started my takeoff.

"After the aircraft had gone through transitional lift and was approximately 20 feet above the ground, with 20 knots airspeed, I heard an explosion in the engine and the aircraft nosed to the left, losing rpm. I applied right pedal and started a full flare because the ground sloped away toward the south. I started to level the aircraft at about 10 feet and did everything I could to keep it from nosing over. As it settled, I applied pitch and I heard the main rotor strike the aircraft. . . ."

Report: ". . . The pilot autorotated into the POL area which was straight ahead in line with his flight path. The POL area has a 10-percent slope to the south and the pilot used a full flare to stop the forward speed and keep the aircraft from traveling further downhill. This caused the main rotor blades to strike the tail rotor drive shaft in the vicinity of the 42-degree gearbox. The drive shaft was cut in two and the tail boom was damaged."

Pilot: ". . . After the aircraft stopped, I turned the fuel and all switches off."

Question: "Did you remove the top half of the particle separator during your preflight?"

Answer: "No."

Question: "Why not?"

Answer: "I knew we were to inspect the particle separator for completeness and to see if any Dzus fasteners were missing. I did not know that I was supposed to inspect the plenum chamber and enter a daily sign-off on DA Form 2408-13."

Unit operational officer: "Approximately three weeks before the accident, while I was a platoon leader, a meeting of all aviators was held and a message was read pertaining to inspection of aircraft to prevent FOD. It was my understanding that the AC was responsible for checking and signing off an inspection of the air inlet section and Dzus fasteners, which we were doing all ready. The particle separator and plenum chamber were checked daily by the crewchief.

"A week later, I became operations officer, and approximately two weeks after that, this accident occurred. Immediately following the accident, I was informed that the AC was to inspect the air intake of the engine with the particle separator removed prior to every flight. Before, I had not required my ACs to remove the particle separator due to my misunderstanding of the information that had been put out."

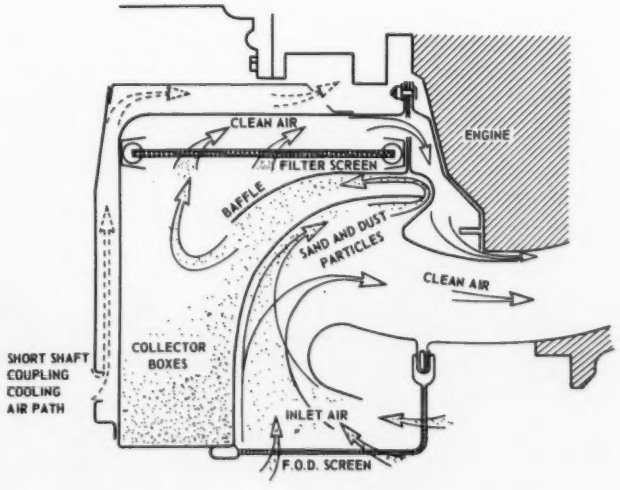
Analysis: "An envelope which had contained a thrust washer was found lodged against the fixed stators of the engine at the 9 o'clock position. Maintenance personnel and an engine specialist concluded that the envelope blocked the airflow across the compressor. This created a vacuum and caused a vibration in the second stage of the compressor as the blades turned from an area of high pressure into the vacuum, causing the second stage compressor to fail.

"The engine was examined and the fixed stators and first stage compressor were not damaged in any way. This confirmed that the damage was limited to the failure of the second stage compressor.

"The aircraft entered maintenance for a periodic inspection. The team leader of the PE crew contacted the sheet metal shop and arranged for a particle separator to be installed. This work was not requested on a work order. It was the policy of the former commander not to work-order small jobs in order to shorten maintenance down-time. The particle separator was installed, but the installation was not inspected by a technical inspector. This was due to two reasons—(1) The lack of a work order led to the absence of any writeup on DA Form 2404. The technical inspector who inspected the aircraft used the 2404 as his guide about what work had been accomplished and what to inspect. (2) The PE team leader also failed to inform the technical inspector about the installation of the particle separator.

"A member of the PE team used the thrust washer that was packed in the envelope later found in the intake chamber of the engine. He left the envelope in the vicinity of the transmission on the engine deck. The pilot who flew the test flight on the day before the accident stated that he inspected the particle separator and intake area of the engine prior to his test flight. The crewchief stated that he in-

"During the crewchief's daily inspection for a flight, he will open the cowling, remove the air filters and remove the top half of the particle separator for inspection."



spected the particle separator and engine intake area during his daily inspection after the test flight on the day before the accident. Both reported that they did not see the envelope.

"The envelope apparently blew into the engine intake area during the runup prior to the first test flight. The engine cowling was open and the top half of the particle separator was removed during this runup. After he completed the runup, the pilot checked for any oil leaks before buttoning up for the test flight.

"It is possible that the pilot involved in the accident could have found the envelope if he had inspected the engine intake area. He stated that he did not know this inspection was required. His operations officer also stated that he did not know the inspection was required. Adequate oral and written instructions had been issued regarding the inspection of the particle separator and engine intake area. In addition, the commander had issued oral instructions to all pilots concerning the required inspection three weeks prior to the accident.

"The envelope was probably lodged in the engine intake area between the 5 o'clock and 7 o'clock positions. It became dislodged during takeoff and caused the second stage compressor to fail."

Findings: "Failure of the second stage compressor caused by thrust washer envelope in the intake chamber of the engine.

"Failure to inspect engine inlet area during preflight.

"Failure of supervisor to understand oral and written instructions and to insure that subordinates understood and complied with instructions.

"Failure of PE team member to properly police his work area for all foreign material after performing maintenance.

"Failure to work-order the installation of the particle separator. This led to the failure of the technical inspector to inspect the particle separator for correct installation.

"Failure of the PE team leader to insure that a technical inspector inspected the installation of the particle separator."

Recommendations: "That all modifications be work-ordered to insure that all maintenance work is properly recorded on DA Form 2408-5 and DA Form 2408-13.

"Emphasis on the responsibilities of the chain of command to subordinates in the area of maintenance instruction and supervision at the next commanders' meeting.

"Emphasis on the importance of policing maintenance work areas for all foreign material."

Commander: "Concur with the findings and recommendations. The responsibilities of officers and NCOs for supervision of every aspect of the maintenance program have been reviewed and discussed in commanders' meetings and aviation safety meetings. Command responsibility for maintenance and for support of the FOD program will continue to be stressed in the future. . . . Work orders are required for all work done by. . . ."

"The pilot or copilot of the first intended flight of each day will personally inspect the particle separator and plenum chamber for foreign objects."

Night Thunderstorm Vertigo

At night over the ocean in a severe thunderstorm with heavy rain and lightning, both AC and pilot became disoriented and experienced vertigo . . .

A UH-1D, WITH A crew of four and five aviator passengers aboard, took off approximately 15 minutes after official sunset for a flight to deliver the aviators to another station. The weather at the point of departure was 2,000 feet scattered, estimated 4,000 feet broken, with 5 miles visibility and light rainshowers. Weather at the destination was 1,300 feet scattered, estimated 2,000 feet broken and visibility 6 miles. Thunderstorms, coming in from the west over mountainous terrain, were prevalent in the area.

AC: "When we left, the weather was VFR and I had no trouble getting 1,500 feet. I flew down the coast toward our destination and called operations to inform them that I was en route. I gave an estimate of 20 to 25 minutes for arrival. Shortly afterwards, we descended in order to remain VFR.

"After crossing a river we encountered rain but still had sight of the ground. My pilot asked if I was

all right, meaning if I had vertigo. After getting no response from me, he said, 'I've got it,' and I released the controls. When he had the aircraft on instruments, I felt we were over the ocean and told him to correct. He did. In the meantime, I contacted operations and requested that they have the GCA warmed up to assist us with radar. The pilot had vertigo at this time and I took control. He said I was in a left bank. I believe he was about to take control again, but then we crashed.

"The last altimeter reading I saw was 300 feet. I remember rolling several times and then unstrapping my seat belt."

Pilot: "When we left, we could see stars and the sky condition was scattered. When we reached the river, the AC tried to contact GCA. Before the GCA became operative, we went IFR and the AC experienced vertigo. I took control.

"We discovered we were over the ocean and I turned 270 degrees. The AC caught sight of land and told me to head 180 degrees. He saw more land and took over VFR. I looked out of my window to see if I could see the land. When I came back on the instruments, we were in a left descending bank. I had vertigo, as did the AC. That is all I remember until we were helping people up onto a dike."

Gunner: ". . . the weather started getting bad. I didn't know our altitude at this time, but we were completely IFR. A short time later, I noticed the altimeter was reading 300 feet. . . .

"All at once, the ground appeared and I saw a dike. I tried to warn the AC that we were too close to the ground. I said, 'Pull pitch. We're going to crash,' but he evidently didn't hear me. The next thing I knew we struck the ground. After the aircraft became stable, I unfastened my seat belt and helped the pilot out of his seat. . . ."

Aviator passenger: ". . . I was sitting on the console of the aircraft. . . . I believe that around the river, the ceiling dropped drastically. To keep ground reference, we descended to approximately 300 feet. I was monitoring the instruments and it appeared to me that the pilot and AC were getting vertigo. . . . The last thing I think I remember is that we were at 100 feet altitude. I did not notice the airspeed. I was tossed from the aircraft by ground contact."

Aviator passenger: "I was riding on the right side of the passengers' seat. It was not raining on takeoff, but we met some heavy rainshowers and lightning over the river. The AC elected to go on. I believe he got vertigo and gave control to the pilot who started a right turn. In a few seconds, he took the ship back and started to lose altitude. I saw the ground coming up fast and we crashed. I believe we hit at approximately 80 to 85 knots. I feel the biggest factor that gave the pilots vertigo was the lightning."

Aviator passenger: ". . . there was lightning and I had a hard time seeing the ground after a couple of flashes. It seemed that I lost my night vision."

Aviator passenger: "We got caught in a severe thunderstorm with heavy rain and lightning at the river. I put on a helmet and asked if they had the beacon tuned in. They said their ADF was inoperative and that they had called for GCA. Shortly after, we hit the ground, throwing most of the passengers out."

Flight surgeon: ". . . both the AC and pilot became disoriented and experienced vertigo. They subsequently flew into the ground, which fortunately consisted of rice paddies, at approximately 1,000 feet per minute descent and 70 to 90 knots airspeed. The result was total destruction of the aircraft.

"The AC had multiple abrasions and lacerations about his face, forehead and scalp. Several required sutures, but none were serious. He did not sustain his injuries until after the crash when, finding himself strapped in his seat in an upside-down position, he unsnapped his seat belt and fell against the circuit breakers in the ceiling.

"The pilot had minor abrasions and contusions about his face and nose, with one minor laceration. His helmet fortunately remained secure during the accident. Judging by the damage to the helmet, this most likely saved him from a fatal head injury.

". . . Most of the survival gear was lost or destroyed during the crash. They did manage to find a strobe light and several flashlights that later facilitated their rescue. . . ."

While injuries to the remaining occupants were not described in detail, all escaped with minor injuries, except for the crewchief who sustained a back injury.

AFTER LOSING ITS tail rotor, a helicopter went into a tight downward spiral over a grove of trees. *Fight surgeon:* "The aircraft fell into the trees, the main rotor beat itself to pieces on the trees, and the ship caught fire. . . The pilot suffered a fractured vertebra and was unable to exit, although he did open his harness and remove his helmet. The aircraft commander was uninjured in the crash, but the instrument panel collapsed, trapping his foot against the floor and making exit impossible. He removed his helmet and opened his harness. . . .

". . . The pilot was partially out of the aircraft and the aircraft commander's foot was almost free when the aircraft exploded. . . . The pilot was thrown from the aircraft, separated from his seat, and landed 50 feet forward and to the left, sustaining fatal injuries. . . . The aircraft commander remained in his seat, which was partially torn loose, but struck his head on the rocket sight or panel when thrown forward. This caused the fatal wounds. . . .

"The major human error in this accident was the removal of their flight helmets by the aviators. It is axiomatic that one never removes his helmet, except when well away from the accident or already in a rescue vehicle. This error cost the aircraft commander his life."

RED
X
NEEDED

AN OH-6A PILOT was en route to his unit's AO when he developed radio difficulties and elected to return to his base.

Report: "The pilot entered traffic and began a normal approach to a hover. As he was terminating at a high (8 to 10 feet) hover, he began to turn left toward the POL area. At this point, the engine failed. The aircraft yawed to the left and the pilot, at first suspecting tail rotor failure, checked his instruments and saw that the engine had failed. He attempted to turn back to the runway heading and gain forward airspeed to perform an autorotation.

"The aircraft struck the ground left skid and tail low. The tail boom separated upward initially as the tail stinger hit the ground and one main rotor blade flexed down, striking the tail boom and completely separating it from the main body. The aircraft bounced and struck the ground 12 feet from the point of initial impact, again left skid and tail low. It bounced again and struck the ground a third time 13 feet from the second impact, slid forward approximately 26 feet, and came to rest upright. . . . The pilot and observer escaped injury.

"Inspection revealed that a fuel line was disconnected at the upper end. The lower fitting of the fuel shutoff valve protrudes into the fuel cell approximately 2 inches. This enabled the engine to run for approximately 35 minutes. When the fuel level dropped below the lower portion of the fuel shutoff valve, fuel starvation occurred."

Mechanic: "Another mechanic and I were putting a new fuel line on the aircraft. While we were taking the fuel cell plate off, the shutoff valve broke on the plate of the fuel cell. We finished taking off the cover and replaced the old fuel line with the new one, connecting the bottom part of the line only. Then we put the plate back on the fuel cell, leaving the top of the fuel line unfastened. I then put about four bolts in the plate to keep dirt from getting in the fuel cell. I put the floor panel back, putting four screws in it to keep the wind from blowing it away.

"The fuel line was left disconnected intentionally because we had more work to be done on the aircraft. We were told not to safety wire the valve in the open position because it is a red X condition. I don't know who finished putting the bolts in the fuel cell or the floor panel."

Line chief of another unit: "I was instructed by the assistant maintenance officer to have the mechanics safety the broken shutoff valves on two OH-6s to the open position and get the aircraft ready for flight the next day. I instructed the section chief to safety the fuel shutoff valves to the open position and to prepare the aircraft for flight the next day. After the work was completed, I inspected it and found it to be satisfactory. I released the aircraft from maintenance to fly."

Section chief: "I was told by the line chief to reinstall the bolts in the top of the fuel cell. He also told me to safety wire the broken fuel shutoff valve to the open position. I asked him to inspect my work and he did.

"I then towed the aircraft out to the refueling area and serviced it. I inspected for leaks and found that the fuel line from the shutoff valve to the aft area of the aircraft was leaking. I tightened it and the leak stopped. I swabbed the fuel from the top area of the cell. Then I was told to replace the access panel to this area. This was done so that the aircraft would be ready for flight the next morning."

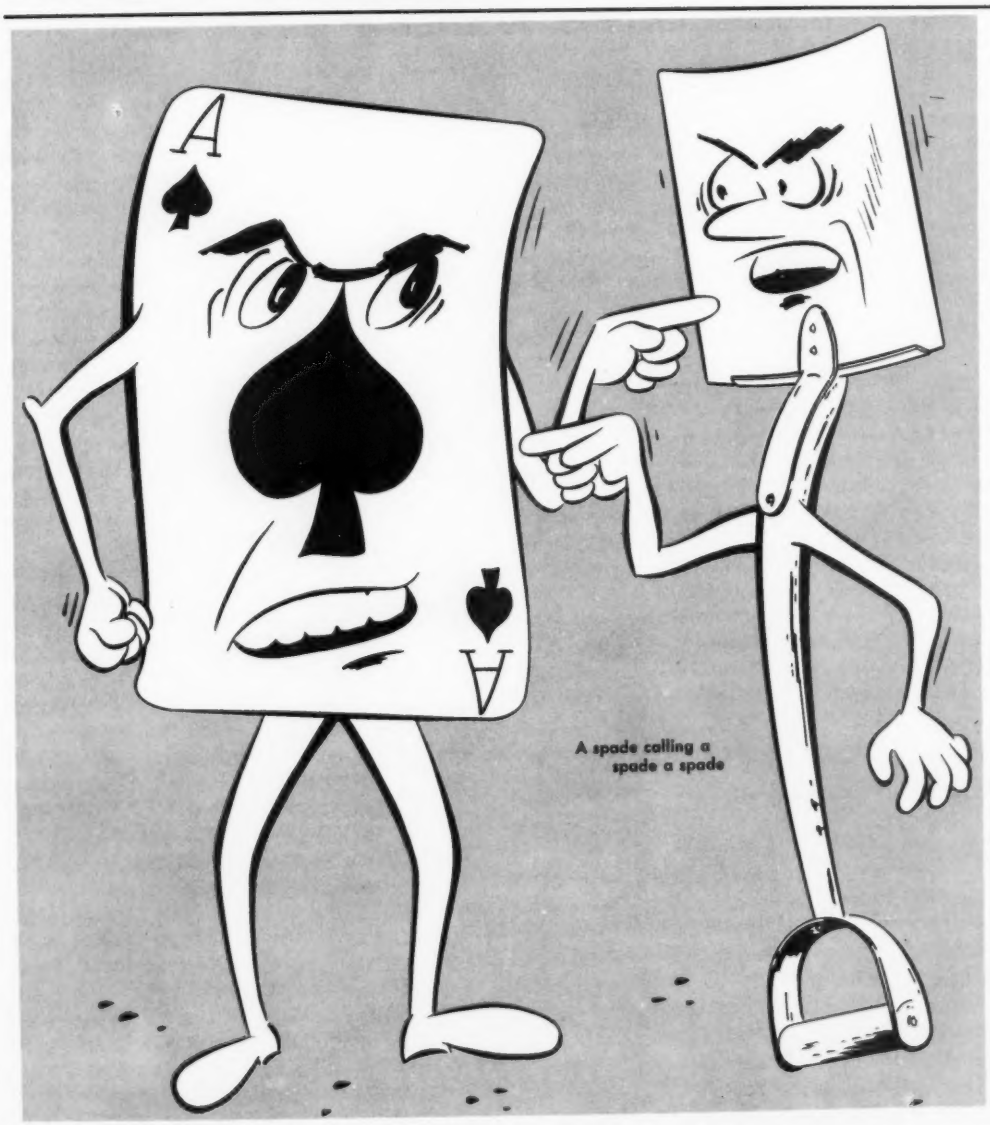
Assistant maintenance officer: "I was told by the maintenance officer that the broken fuel shutoff valve was not a grounding condition and to safety wire it to the open position. . . . My men safety wired the fuel shutoff valve to the open position and closed up the panel."

Report: "The cause of this accident was a fuel line which had been left disconnected by maintenance personnel. The aircraft was on a red X condition for a broken fuel shutoff valve, but no entry appeared in the log book showing the fuel line disconnected. Later the same day, maintenance personnel of another unit determined the fuel shutoff valve was serviceable, replaced the fuel inspection plate and access panel, and released the aircraft for flight, unaware of the loose fuel line."

Recommendations: "Positive action at all levels of aircraft maintenance to insure that all red X conditions are recorded in log books. This will prevent a dangerous condition from being overlooked when one mechanic cannot complete a job and another is assigned to complete it.

"Strict adherence to maintenance control measures. All maintenance at one level should be completed and the aircraft physically signed over to the next level of maintenance before any maintenance is performed at that level."

WHEN IS A SPADE A SPADE?



A spade calling a spade a spade

A lack of communications in several aircraft accidents has been extremely costly in lives, equipment and combat effectiveness

Lieutenant Colonel Lester R. Kerfoot Jr.

COMMUNICATIONS . . . giving and receiving of information, signals, or messages by talk, gestures, writing, etc.: *Webster*.

S. I. Hayakawa, acting president of San Francisco State College and noted semanticist and author, in his books "The Use and Misuse of Language" and "Language in Thought and Action," writes about one form of communication as an interpersonal relationship in which the receiver demonstrates his understanding of what the sender means by performing an act exactly as intended by the sender.

While these definitions may sound stuffy and overly academic, they are highly pertinent and directly related to aviation safety. I have investigated several aircraft accidents in which the lack of communications had severe results. Eight fatalities resulted from one and two other aircraft were so badly damaged that they had to be evacuated from overseas to CONUS for repair. All three were extremely costly in lives, equipment and combat effectiveness.

A Chinook left one LZ for another on a troop transport administrative mission. The passengers, an infantry platoon and a portion of a company headquarters, were oldtimers in airmobile operations, very familiar with riding in helicopters.

Prior to takeoff, the aircraft commander asked the flight engineer, "Chief, how many we got?" and "Is all secure?" The actual meaning of these questions was, "How many passengers do we have on board?" and "Do they all have their seat belts on, in compliance with unit SOP?"

The flight engineer responded, "Twenty-nine, sir, and all secure." The inferred meaning of this statement, as understood by the aircraft commander, was "We have 29 passengers on board and they are all properly restrained in their seats." With this understanding, the aircraft commander was satisfied that all provisions of the SOP had been met and he took off. What the flight engineer actually meant was, "We have 29 passengers on board, all have seats and there is no loose equipment strewn about the helicopter."

The Chinook proceeded to its destination and the approach was started. At approximately 150 feet out on final and 40 to 60 feet in the air, it slung an aft rotor blade—the result of a previous accident in which the crew exceeded the design limitations of the blade—and crashed. The flight engineer and seven passengers, including the company commander, were killed—BECAUSE THEY WERE NOT RESTRAINED IN THEIR SEATS.

This was a dramatic example of the flight engineer not understanding what the aircraft commander meant by his questions. The aircraft commander, in his familiarity with the situation, the aircraft and the mission, *thought* the flight engineer understood what he had asked in *his*—the aircraft commander's—terms of reference. The flight engineer *did understand* what the aircraft commander had said, but in his own—the flight engineer's—terms of reference. They simply did not communicate.

Had the aircraft commander asked his second question as he meant it, and had the flight engineer understood it as it was intended, it is likely that only one fatality would have resulted, based on analysis of structural damage to the helicopter.

The two remaining accidents were similar in nature. In these, however, we have the questions, "Who is flying the helicopter?" or "Is it flying itself?" or "I'm helping you!?"

A UH-1 was returning to its home LZ on a particularly bad day, with a ceiling of 300 feet and visibility almost 1 mile. A newly arrived pilot, with 1,800 plus UH-1 hours, was flying and a pilot with 600 total hours, who had been with the unit 4½ months, was the aircraft commander. They were forced to fly low level for maximum security.

After crossing a stream and coming upon a small

WHEN IS A SPADE A SPADE?

ridgeline, their engine failed. The pilot flared, regained rpm into the green, and touched down, skids level with the ground, on a slight slope. The helicopter proceeded along the ground for 32 feet, became airborne again for 50 feet, then touched down again, skids level with the ground and well implanted on the slope.

The aircraft commander became overanxious and decided to help the pilot. Shortly after the second touchdown, he bottomed collective so they wouldn't, as he reported, "go too far and hit a small terrace." Whether they would or would not have hit the terrace, uphill from their ground path, is purely academic. The result was not academic. The skids dug into the rain-softened earth, pushing dirt through the chin bubble, and rocking the helicopter dangerously forward. The pilot's reaction was natural and understandable—aft cyclic.

With the abrupt application of aft cyclic, at low rotor rpm, the inevitable occurred—mast bumping and a tail boom chop just aft of the synchronized elevator. Scratch one helicopter.

The aircraft commander failed to communicate with the pilot. He did not state, "I have control of the aircraft," or "You have control of the aircraft." He did not keep his hands off the controls when the pilot, who had been flying, naturally assumed that he had control. He did not advise the pilot when he was going to apply downward pitch so the pilot could have been forewarned. More meaningful, there had been no communications between them prior to takeoff about who would do what in an emergency. This example shows the necessity for communications in pre-mission planning.

The next accident involved the same aircraft commander, who by this time had been appointed an instructor pilot. On this day, he was logging pilot time, while another aviator was aircraft commander.

Returning from a mission, the crew heard a loud bang and a grinding noise from the tail boom area. The aircraft commander immediately entered autorotation and rolled off the throttle. Since the pilot was also an instructor pilot, the aircraft commander asked, "Would you get on the controls with me?" The pilot/instructor pilot agreed and on the way down they experimented with the antitorque pedals and found they had full control. At this point, the helicopter was approximately 75 feet above the ground and over the clear flat area they had selected for touchdown.

Since it appeared they had full control, they decided to make a power recovery and fly back to their home LZ—with both aviators still on the controls. They pulled collective for the power recovery and promptly dropped in from approximately 15 feet. Neither had rolled the throttle back on. EACH THOUGHT THE OTHER HAD DONE THAT.

This was another case of two on the controls, with neither having positive control of the helicopter, and neither knowing who was doing what or with what.

As it had in the previous accident, the aircraft accident investigation board recommended that there be a positive announcement about who was flying the helicopter.

Aviation schools learned long ago that there must be a positive transfer of aircraft control between instructor pilots and students, so that only one person operates an aircraft at any one time. Unfortunately, this knowledge is not always carried away from the schools. Nor, as these accidents illustrate, is this knowledge gained through experience.

Remedial action for communication failures is relatively simple:

• Do not *assume* that any other person understands what you *mean* to say, whether you make a statement or ask a question.

• Always give orders to or ask questions of another crewmember in *his* terms of reference and in the words and phrases he best understands and uses to get your meaning across. Among communicators, this is known as empathizing or experiencing with another, as illustrated by the first accident described. The aircraft commander should have asked explicitly what he intended to mean by his questions, rather than what he asked.

• When there is to be a transfer of aircraft control, it must be positively and verbally announced. Only one aviator can safely operate an aircraft at any one time.

• Prior to takeoff, as part of the pre-mission planning and briefing, there must be a full and complete understanding about what each crewmember will do in an emergency. There is never time to decide upon divided actions in emergency conditions. This full and complete intercrew understanding and communications must be presented to successfully cope with unexpected events.

Call a spade a spade, but be sure your listener knows *which* spade.

MISSION

ACCOMPLISHMENT?

TEN UH-1s DEPARTED in trail formation en route to pick up troops at another site for a scheduled mission. Overhead weather was clear at the takeoff site, but the flight encountered fog and haze immediately after takeoff. However, they landed successfully at the PZ and the troops were loaded aboard.

At this time, the flight commander was advised the weather was marginal over the operations area and a delay was suggested. The flight commander took off, flight checked the weather and decided that, although weather was marginal over the PZ, the weather over the operations area was broken enough for the mission. He called the flight leader and told him to bring the aircraft to the operations area.

The flight took off, proceeded northwest, and the flight leader informed the flight commander about his location and reported he was encountering clouds at 1,000 feet. He did not have visual contact with the ground or the C&C helicopter. He then told the commander that he was going to establish a left orbit, as he was passing over the operations area. The commander acknowledged and suggested he descend to 900 feet where the weather was better.

The flight leader made a standard left turn and descended to 900 feet. After turning from northwest through south and east to a heading of 60 degrees, he entered a cloud. Breaking out of the cloud, he saw the C&C helicopter approaching his immediate right front at the same level. He broke down and left and the C&C aircraft attempted to pull up and left. The rotor blades of the second UH-1 in formation struck the tail rotor section of the C&C helicopter and the C&C helicopter exploded. The main rotor and transmission separated from the number two UH-1 and the fuselage crashed inverted.

The other pilots took evasive action to avoid the falling debris, but number four UH-1 struck the wreckage, severing its main rotor and tail boom. It crashed and exploded.

There were 29 persons aboard the three aircraft. None survived.

Although the area directly over the takeoff area was clear, the official weather statement, taken less than 5 miles from the crash site, reported fog which had become thicker during the preceding hour, with clouds at 800 to 1,000 feet and 3,000 feet, with 3 miles visibility. Visibility to the southwest was one-fourth mile. All the remaining pilots of the flight stated they flew through fog, clouds and haze, with visibility restricted at times to the point that they were unable to see all the helicopters in the flight.

Cause: ". . . commander allowed operations in less than marginal weather."

Reviewing official: ". . . The commander was fully aware of the marginal conditions in the area. However, he attempted to launch the operation in spite of the hazards . . . *This accident illustrates the hazards associated with an unrealistic sense of mission accomplishment. While it is acknowledged that mission accomplishment is paramount, it must be emphasized that this mission was not accomplished, nor was there any factor of such great import that it dictated against delay until the weather dissipated.*"

ADMINISTRATIVE WIRE STRIKE

PARAGRAPH 2-3, AR 95-2: *"Careless or reckless operation.* No aviator will operate an aircraft in a careless or reckless manner which endangers the lives or property of others."

An OH-23G, with a pilot and crewchief aboard, took off for an administrative flight. Approximately 10 to 15 minutes later, the helicopter was turned to a westerly heading, approximately 75 feet above the ground. It flew between two ridges and was approximately 20 feet above the ridgetops, maintaining level flight for approximately 200 yards where it struck three ⅛-inch steel telephone wires spanning the ridgelines.

The bubble hit the wires first, breaking the plexiglas and injuring the crewchief. The wires continued up the bubble until they contacted the collective pitch control rod, cyclic control rods and transmission case. The wires then bent, pinched in the collective pitch control rod and caused it to break just above the lower rod end. The wire then became entangled around the 5-inch drive, 1-inch drive shaft, tail boom, tail rotor and tail rotor gearbox. The tail rotor pitch control cable was broken.

With directional control and collective control lost, the helicopter yawed to the right and began a gradual descent in the original line of flight. Four hundred feet from the initial wire strike, the main rotor blade cut eight additional powerlines, then struck the face of a building 12 feet from the ground, breaking the mast. As the helicopter continued into the building, the transmission struck an 8-inch overhead beam and was knocked off. The wreckage came to rest approximately 10 feet inside the building, lying on its left side.

Pilot: ". . . After departure, I climbed to 1,500 feet indicated. From this point on, I am unable to recall what followed, except for just a few incidents. I can recall the aircraft yawing to the left and entering autorotation. Next, I recall striking a wire. After this, I was trying to help my crewchief get unstrapped from the aircraft. Next, I was in the home of . . ."

Crewchief: ". . . the aircraft was flying at about 75 feet between two knolls in the city. The tops of the knolls were just about even with the height of the aircraft. We were flying, I believe, in the general direction of . . . The pilot knows someone who lives in that area and I believe he was going to fly over her house. I believe we were still flying straight up the depression between the two knolls when I felt the first impact. Plexiglas hit my face and I felt an impact and pain in my right arm. I looked down and

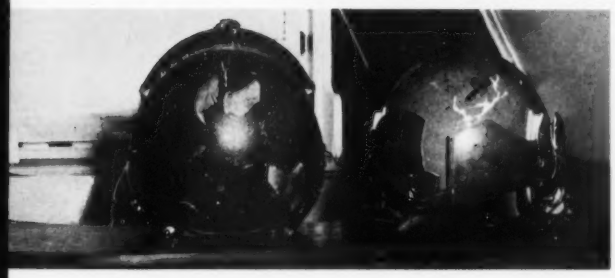
Main rotor struck top of building and helicopter crashed into building. Photo was taken after helicopter was righted and drug from building

my right arm was all curled up toward my chest. The hand was in a funny position and I was bleeding . . .

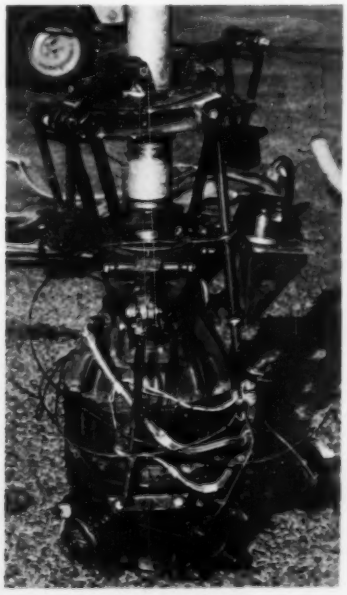
"The aircraft came down through some wires, the tail whipped around to the left, and the helicopter was leaning against the side of the building at about a 45-degree angle. I was on the bottom. My right arm was twisted across my chest and a 4 by 4 was in front of me . . ."

Flight surgeon: ". . . Fragments of the plexiglas caused a deep laceration in the crewchief's right arm, severing an artery and nerve . . . The pilot's head struck the upper edge of the instrument panel, shattering the visor and visor guard, and cracking the helmet. The crewchief's head struck the door and doorframe which had partially collapsed into the compartment. Neither the pilot nor the crewchief sustained any head injury. The pilot had minor superficial abrasions . . . Recommend the importance of the crash helmet be stressed as it was instrumental in the survival of both the pilot and crewchief."

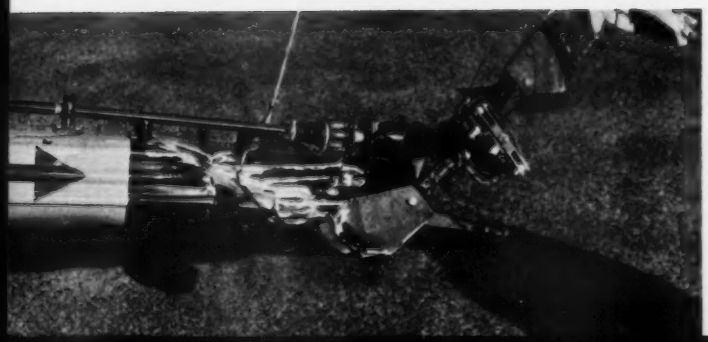
Pilot's (right) and crewchief's helmets show impact forces. Flight surgeon stated helmets were instrumental in survival of both



Arrow shows where helicopter struck wire between knolls



Wires wrapped around transmission and severed collective control rods



Wires around tail rotor severed tail rotor control cable

LESSON LEARNED

LETTER TO ALL unit personnel from CO: "1. Running takeoffs will no longer be performed by any aviator assigned to this unit. Pre-takeoff hover checks will be performed prior to each takeoff.

"2. Any helicoper which cannot be stabilized at a hover without rpm bleedoff is obviously overloaded. All UH-1H helicopters are placarded with the required pre-takeoff hover checks and these will be performed without fail prior to each takeoff, as applicable to each type of operation. All UH-1C helicopters are placarded with the gunship pre-takeoff hover check and this will be performed prior to each takeoff.

"3. Any bleedoff of rpm will require judicious offloading of passengers, cargo or ammunition in sufficient quantity to allow stabilized hover with no bleedoff of rpm. Fuel burnoff may be used to accomplish this load reduction.

"4. The only exception to this policy is when the situation is clearly a matter of life or death and the necessity for not adhering to pre-takeoff hover checks outweighs the margin of safety that they afford."

Approximately one month after this letter was written, one of the unit's UH-1Hs was carrying a load of supplies to a hilltop camp.

AC: "After turning on final, we were confronted with a situation where the clouds were hanging below the level of the landing pad. The pilot went down far enough to clear the bases of the clouds.

"About 600 meters out from the pad (we were

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lower than the pad), I told the pilot to get some altitude back. His airspeed was down to approximately 45 knots indicated and he started applying power and went into a slow deceleration. By this time, we were about 200 meters out. The ship wasn't climbing and the pilot added more power. As he did, I was watching the tachometer and saw that we were losing rpm steadily. I would say that it was at this point I knew we weren't going to make the pad. I estimate our airspeed was no more than 25 knots indicated. I got on the controls with the pilot. The last rpm I remember seeing was around 5900. I was so involved with setting the aircraft down that I can't remember any readings after that.

"The aircraft was vibrating rather strongly prior to impact. I didn't notice any roughness or unusual vibrations in the controls.

"We picked the best spot we could find with our limited capabilities. We were able to clear the trees on the side of the hill and actually flew the aircraft to the ground, pulling what pitch we had left just prior to impact. The aircraft handled well throughout the approach and we still had antitorque control when we landed. I don't remember any noises or vibrations that wouldn't be normal with the low rpm state we were in."

Report description: ". . . the aircraft settled into the hillside with little or no forward momentum. It sat there momentarily until one rotor blade swiped the ground in front of the aircraft and started it rolling to the right. The blade next hit a small stump and pieces of the blade were thrown approximately 100 feet up the hill. The aircraft settled on its right side inverted in a garbage pit that had burning garbage in it. The fuel cells ruptured and spewed fuel profusely. During this time, the crew and passengers got out and some personnel from the base extinguished small fires in the area. The engine continued to run until a large fire caught and consumed the aircraft."

AC: "There were many factors which, had I given more thought to them, could have prevented the accident. Most of these I didn't consider on the day of the accident. The first was a hover check. We made a hover check which could be described as insufficient for our load and the pad we would be landing on. There is approximately 2,000 feet elevation difference between the pickup point and the pad we were to land on. I didn't give this much consideration, as I had landed on that same pad many times.

"The next thing, which should have been first, was aircraft loading. I saw to it that the weight was distributed evenly and as close to the cg limits as possible. I didn't stop to count the number of cases we had on board, so I didn't have even a close idea about the weight of my ship when I took off.

"Another thing I missed was crew safety. I was unaware that my crewchief's sleeves were rolled up until after the accident investigation.

"I should have made the approach myself, knowing our load was heavy and that my pilot hadn't been flying much in the past month. . . . So I pushed myself beyond all the limits that would have given myself and my crew a reasonable margin of safety. Since my accident, I have had checkrides which were long overdue. . . .

"I feel that I have learned a great deal from this accident and through discussing the facts with the other aviators in my unit, the CO and the safety officer, I believe many others have benefited from my mistakes."

Report findings: "1. The crew allowed too large a load to be placed in the aircraft.

Helicopter settled on right side inverted in garbage pit and caught fire from burning garbage

"2. A proper hovering check was not performed prior to takeoff.

"3. The pilot attempted an improper approach and used incorrect procedures to correct the approach.

"4. The AC did not initiate any corrective action until it was too late."

Indorsement: ". . . an additional finding of supervisory error on the part of the AC in that he did not insure the compliance of the crew and passengers with regulations concerning the use of safety equipment and wearing of uniforms.

"The applicable dash 10 indicates that the allowable gross weight for hovering out of ground effect at the elevation of the pad and a temperature of 30 degrees C is 9,200 pounds. The estimated landing weight of the aircraft was 10,089 pounds. This overgross condition was only compounded by the pilot's failure to exhibit proficiency in the approach. Both pilots knew the aircraft was heavy, but did not stop to determine exactly how heavy. . . .

". . . indicated in his statement that the gunner jumped up just prior to the crash. When asked later what his intentions were, he said that he was considering exiting the aircraft when he saw it might crash. Such action represents a lack of understanding of the factors and hazards involved in an aircraft accident and another near noncompliance with SOP. . . .

". . . makes reference to the aircraft entering into a settling with power condition just prior to the crash. This is not correct. The reason the aircraft crashed is because there was not enough power to maintain flight and climb to the intended landing site. This concept of the settling with power phenomenon may be widespread and represents a lack of understanding . . ."

Unit CO: ". . . In the year prior to this accident, the unit had a total of 14 major accidents. I assumed command of the unit one month before this accident and attacked the two major areas contributing to previous accidents—aircraft maintenance and aviator experience.

"Aircraft maintenance received priority initially because the majority of preventable accidents were the result of engine failures over terrain which made it virtually impossible to land without extensive damage. High aircraft availability rates were de-emphasized; supervisors were required to use appropriate dash 20 manuals while performing maintenance; adequate time was allotted for proper inspection techniques; and additional time was used to train all aircraft maintenance personnel. Flight crews were required to perform mandatory postflight inspections and aviators were required to participate in performing intermediate inspections.

"A system of weekly meetings to instruct all aviators in safe flying techniques and to discuss maintenance difficulties was initiated. These meetings, held in the unit messhall, last from two to three hours each. The accident prevention officer and the engine tech rep have been guest speakers. I conduct the meetings and their purpose is to raise the professional level of all aviators in the unit through controlled 'hangar flying.'

"The results of these actions have been that the unit has not experienced an engine failure or any other serious inflight emergency for the past two months. Since this accident, the unit has successfully completed its first accident-free month. The lessons learned from this accident have proven valuable in this achievement.

"This accident was thoroughly discussed in the meeting held two days after it occurred. The cumulative reasons for the inevitable crash were covered in detail and the incorrect and correct procedures minutely analyzed.

"Another meeting a week later was almost a repeat, except that this time the AC and pilot got up in front of their colleagues and explained all of the things they did wrong. I feel that the identification by all unit aviators with the two highly embarrassed pilots probably did more to instill safety consciousness than all of my talking prior to this accident. Since that time, the aviators of this unit have been the most receptive group to accident prevention talks that I have seen during more than 12 years in Army aviation. I fully attribute their interest and accomplishments in accident-free flying to the lessons learned from this accident and by the use of the two pilots involved to analyze and correct deficiencies in knowledge that cause accidents.

"In addition to the items mentioned, the unit has published detailed crew duties and a list of the responsibilities of aircraft commanders. It has initiated more detailed and thorough inspection procedures and is conducting a safety education program for passengers and users of Army aviation. Accident prevention is cumulative and the continuing active participation by all members of the unit tends to snowball our efforts by continually uncovering new ways to do more things more safely than before.

"The results achieved by any aviation unit in the field of accident prevention is in direct proportion to the amount of emphasis by the commander and the desire for willing participation of all members of the unit. . . ."

OIL BOTTLE ANALYSIS

Experiment showed oil sample bottle eventually rolled to this position with stick behind neutral

When stick is moved forward, bottle slides into slot, restricting aft control movement

Maximum up travel with stick in full rearward position with bottle blocking control

O-1D PILOT: "I had flown for an hour and was on my landing approach. As I attempted to round out, the elevator controls locked. I tried to pull the stick back with both hands, but it would only come back part way.

"I applied power, trying to raise the nose and make the field. When I saw I had the strip made and that the nose wasn't going to come up enough to avoid a crash, I decreased power, holding the stick back as far as possible. The aircraft hit on its main gear and propeller and bounced into the air. I again applied power to keep the nose up as much as possible. The aircraft settled hard and began to bounce down the runway. The left tire was flat and it began to go off to the left side. I applied full right brake, but it was still going off to the left. I then applied both brakes to avoid the ditch to the left of the runway and the aircraft flipped over on its back. I was unhurt and I got out and turned off the switches."

Crewchief: ". . . two oil sample bottles were placed in the aircraft, one in the socket of the rear stick control assembly and the other behind the kick panel on the right side. . . . I did not tell the pilot about the bottles. . . ."

Report: "The aircraft had been operating out of an isolated airstrip for an extended period. Oil changes and intermediate inspections were performed by the crewchief at the airstrip and the aircraft was returned to base for periodic inspections. Oil samples taken at the airstrip were delivered to the base in the aircraft. The unwritten procedure for transporting oil sample bottles was to place

one bottle in the rear seat control stick socket, with the stick stowed in its brackets. Additional bottles, if any, were placed behind the rear seat radio kick panel. This panel is set in place to prevent a passenger or observer from damaging the radios under the seat. It is not usually fastened down and can slip aside or become partially dislodged.

"The boot around the rear control stick and left side upholstery in the rear cockpit had been damaged and removed. DA Form 2408-13 reflected the removed boot prior to periodic inspection, but a new boot was not available. Since the PE, 'boot removed' had been carried forward daily on the dash 13. . . .

"After the accident, a technical inspector was unable to find any malfunction, rigging discrepancy or assembly error that could account for the loss of control movement. Several items were found in the wreckage that could possibly jam the controls. These included cartridges, cartridge cases, an M-16 magazine, one intact oil sample bottle and three smoke grenades. Further search revealed portions of a broken oil sample bottle cap and shards of the same type plastic were found adhering to the self-locking nut which fastens the rear torque tube pivot bolt. The heavy coat of paint on the forward edge of the control stick hub assembly actuating arm was indented. A new oil sample bottle was placed between these two surfaces and it fitted the indentations perfectly. The bottle was retained in place by the slot in the floor through which the actuating arm works and it restricted the movement of the control stick to the forward half of its travel.

"A similar O-1D was flown with the boot removed and it was discovered that an oil sample bottle rolling on the floor of the cockpit would eventually work its way back and lodge halfway in the slot in the floor. Once it was halfway in the slot, it would remain there through all but negative g maneuvers, though not restricting any control movement. The only way it could slip into blocking position was with movement of the stick considerably forward of neutral, as would be the case with a relatively high speed approach with moderate to full flaps.

"It was found that once the bottle was in place, the aircraft could not be rounded out past a slightly nose low attitude. The addition of moderate power brought the nose up slowly, but did little to slow the rate of descent. The rapid addition of climb power brought the nose up into climb attitude and stopped the rate of descent almost immediately. In this case, power had to be reduced or forward stick pressure added to prevent a high pitch attitude and subsequent stall.

"It was found that a safe go-around could be initiated from short final and no particular difficulty was noted in making a shallow, moderate flap, power approach.

"In inspecting other aircraft, it was noted that a great number of small items are frequently stowed in various places on the pilot or in the cockpit. Many of these, including weapons, ammunition, magazines, flares, smoke grenades, flashlights, survival knives, first aid kits, etc., could cause the controls to jam. Though all of these items may be properly stored during preflight, it is very easy for some of them to come loose during rapid changes in attitude, such as might be used in evasive maneuvers.

"It is also possible for small items to become lost in the cockpit, tucked under pieces of upholstery, or caught between underseat radios. It is believed that some of the small items found in the wrecked aircraft were such lost items. One of these, the M-16 magazine, was found to block the controls even more effectively than the oil sample bottle.

"It was also found that many O-1 aircraft were missing control stick boots. A spot check was made of approximately 20 flyable aircraft and six were found without boots.

"It is evident that this accident occurred when an oil sample bottle slipped into the rear seat control stick mechanism and limited control travel while the pilot was attempting to land. Since it would be practically impossible for an oil sample bottle stowed in the rear seat control stick socket to come out without a negative g maneuver, it was assumed that the oil sample bottle stowed behind the radio kick panel was dislodged and was responsible for the blockage.

"A contributing cause was the presence of the second oil sample bottle. The procedure for handling a second oil sample bottle is inadequate. In addition, the pilot should have been informed of its presence by the crewchief.

"A probable contributing cause was the pilot's reaction when he discovered his elevator controls blocked. While it is possible that this blockage was discovered too late on final to have saved the aircraft by the application of full power, evidence indicated that if full power had been applied, a go-around could have been made.

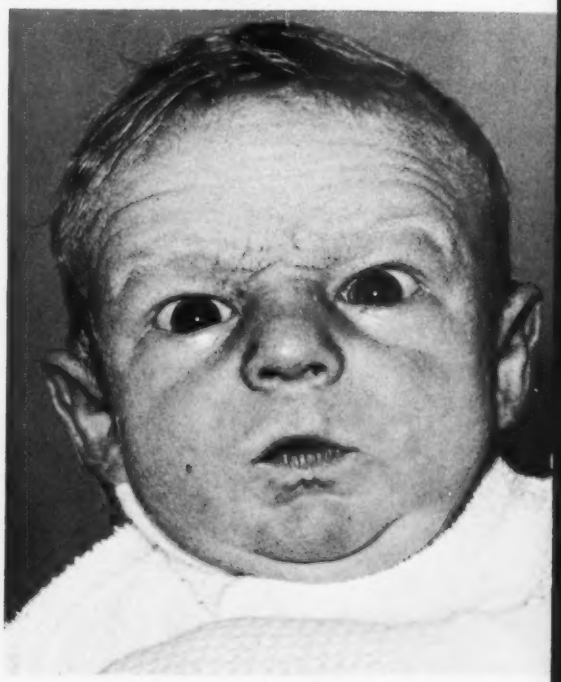
"As this accident was investigated, it was increasingly apparent from remarks, safety discussions, and conferences with many aviators that many newly rated pilots would have reacted in much the same manner. The instinctive reaction appeared to be—'You're so close, let's get it on the ground now.' In addition, some of the younger pilots seemed amazed at the degree of aircraft control possible with some of the basic flight controls inoperative."

Pearl's personal equipment and rescue / survival lowdown

Sorry, gentlemen, but Pearl was baby-sitting this month and couldn't be with us. However, we were able to discuss personal equipment and survival with her employer and he expresses some strong opinions on the subject

"Nobody, and I mean NOBODY, not even the old man, gets me into that stroller without a securely fastened safety belt, and expertly fitted helmet, gloves and boots! I also insist on fire retardent diapers and full length sleeves. You guys better wise up and follow my example."

"You don't wear your personal survival kit? It gets in the way? You stow it in your DIAPER BAG!?"



If you have a question about personal equipment or rescue/survival gear, write Pearl, USABAAR, Ft. Rucker, Ala. 36360

"Get out of my stroller, buster! You're not fit to crew with me!"

FAIR WARNING

A UH-1H, WITH A CREW of four and seven passengers aboard, was en route . . .

Pilot: "We were cruising at 80 knots and 1,500 to 2,000 feet above the ground. I noticed a settling and saw the rpm drop. The aircraft commander started to put the collective down and then he stopped part of the way down. I shoved it the rest of the way down and said, 'Engine failure.'

"The AC flipped to number 2 on guard transmit and called 'Mayday.' As we were going down, I turned the fuel, battery and inverters off. Just before we got to the trees, we saw we weren't going to make the intended landing area, the only open area there was. We saw we were going to hit the trees.

"I saw the trees come through the cockpit and one of them must have hit me. They came through on my side and I wasn't conscious after that. The next thing I remember is feeling myself inverted and my straps were still hooked up. I was hanging by the straps and evidently disconnected the quick release and got out. I don't know exactly how I got out."

"Was your approach into the area straight or did you have to make some turns?"

"It was just about straight in. We may have varied 15 to 30 degrees. I don't think it was any more than that."

"What was your airspeed at impact?"

"It was about 60 knots. I thought the AC was going to flare to clear the trees and build rpm. I kept waiting for him to flare, but he never did."

"Did you have any indication of engine malfunction?"

"Yes. As we got the aircraft, I noticed in the log book that there was not a maximum temperature line on the egt gauge. Consequently, it wasn't easy to read the egt. . . . On the last takeoff before the accident, the AC noticed that we had a high egt reading. It was 640 degrees. This was after we had been climbing out for about 40 to 60 seconds."

"What kind of power were you pulling when you noticed this?"

"We were only pulling 36 pounds. I remember calling it off to him and then looked at the egt and saw that it was way up."

"Why didn't you turn around and go back? Did you comment on that at all?"

"No. He lowered the collective immediately and the egt came back down and stabilized. . . ."

Report: ". . . the aircraft struck several trees short of the intended landing area, then fell into the area on its left side. The main rotor blades showed signs of light blade strikes on the bottom sides. The leading edges were not damaged. This indicated that the aircraft struck the trees with low rotor rpm and a high pitch attitude. After coming to rest, one blade was slightly bent by the fall of the aircraft, but the other blade was left pointing in the air. This was another indication of low rotor rpm. . . . The pilot and gunner were the only survivors. . . .

". . . The following entries were extracted from the 2408-13s of the aircraft. They illustrate a trend of decreasing engine performance which could have

Absence of damage to main rotorblade indicates very low rotor rpm at impact

2408-13 WRITEUPS

DATE (Number of days prior to accident)	STATUS	FAULTS AND/OR REMARKS	ACTION TAKEN
78		Engine oil pressure fluctuates.	Checked gauges. Suspect pressure transmitter.
		Bottom half of engine dirty.	None
73		Engine oil leak.	CF (carried forward)
72		Engine oil leak.	Installed new O ring on scavenge line.
		660° egt for 20 seconds at 47 lbs. torque, 97% N_1 speed.	CF
71		660° egt for 20 seconds at 47 lbs. torque, 97% N_1 speed.	Engine cleared.
68		No. 6 PE completed and hot end inspection completed. Test flight showed max power at psi 49, N_1 speed 97.57, alt 5500, egt 590°, OAT 16° C.	
56		Engine oil temp gauge stays near 100° C.	CF
55		(No writeup appears on engine oil temperature)	
46		Flight No. 1, engine weak, pulled 44 lbs. torque and bled off to 6050 rpm. EGT high during cruise flight.	CF
44		Flight No. 1, engine weak, pulled 44 lbs. torque and bled off to 6050 rpm. EGT high during cruise flight.	Test flown and released. EGT normal.
43		Red line missing on engine oil temperature gauge.	CF (until aircraft crashed)
30		No. 7 PE completed, test flight showed max power at psi 47, N_1 speed 98%, alt 3700, egt 570°, OAT 18° C.	
24		Excessive engine oil consumption.	CF
22		Excessive engine oil consumption.	Uses 3/4 quart of oil in 1-hour flight. Not excessive.
		Flight No. 2, engine oil pressure gauge fluctuated, engine burned excessive oil.	Checked OK.
		Engine oil pressure reads 3 psi high at normal cruise.	CF
	X	Engine nose seal leaking.	CF
		Engine bleeds off rpm at 40 psi.	CF
20		Engine oil pressure reads 3 psi high at normal cruise.	Flight checked OK.
		Engine bleeds off rpm at 40 psi.	Rewritten in detail.
	X	Engine nose seal leaking.	CF
18		Engine rpm bleeds off to 38 psi with normal load.	Adjusted droop cam compensator.
16		Engine using excessive oil.	CF
		Engine weak, 6300 rpm at 38 psi and 98% N_1.	CF
15		Engine using excessive oil.	CF
		Engine weak, 6300 rpm at 38 psi and 98% N_1.	CF
14		Engine weak, 6300 rpm at 38 psi and 98% N_1.	CF
		(Entry of engine using excessive oil 2 days before does not reappear)	
12		(Aircraft sent in for PE and entry of weak power is transferred to 2404.)	
7		(Aircraft test flown and released. Test flight sheet showed max power at psi 42, N_1 speed 98%, egt 580°, alt 3500, OAT 20° C.)	
5		Max power 42 lbs. at 98%.	CF
4		Max power 42 lbs. at 98%.	CF
	X	Flight No. 1, engine oil pressure fluctuated between 20-80. EGT rose from 520° to 600° for 10 minutes in cruise flight, then back to 520°.	One-time flight for test flight.
		Flight No. 2, egt at max power, 98% N_1, 595°, held for 1 minute, oil pressure 91 lbs., 4,000 feet, OAT 18° C, 41 lbs. torque, cruise at 520°.	CF
		Oil pressure fluctuating at flight idle, 10 lbs.	CF
3	⊗	Engine oil pressure fluctuated between 20-80.	Inspected OK. Filled oil reservoir with 5 quarts of oil.
	X	EGT rose from 580° to 600° for 10 minutes in cruise flight, then back to 520° at max power, 98% N_1, 595° held for 1 minute, oil pressure 91 lbs, 4,000 feet, OAT 18° C, 41 lbs. torque, cruise at 520°.	Inspected OK. EGT gauge checked with jet cal and found to be defective. Checked during one-time flight and found normal with new gauge.
		Engine oil pressure fluctuated at flight idle, 10 lbs.	Normal.
	X	Suspect excessive oil consumption.	Inspected OK. Checked during flight, ship used less than 3/4 quart.
		Test flight required for egt fluctuating and suspicion of excessive oil consumption.	Test flown and released.
2		Flight No. 2, oil leak in hell hole.	CF
1		DI due.	(None)
		FOD due.	
		Tail light inoperative.	
		Red line missing from engine oil temperature.	

As the skill level of assigned aviators continues to decrease, the need for formal followup training increases . . .

been detected by a periodic review of aircraft records. They are also indicative of faulty maintenance procedures and inadequate supervision."

FINDINGS:

"Engine failure (teardown analysis of the engine revealed that failure was caused by improper power shaft to compressor rotor clearance).

"Inspection: Aircraft records were not properly maintained and subsequent record checks were either not performed or failed to reveal serious record discrepancies and a significant history of engine malfunctions.

"Supervision: There was definite evidence of inadequate supervision and faulty maintenance procedures, in that writeups were carried forward, then disappeared from the records with no evidence of action taken. Writeups included high egt, high oil temperature, fluctuating oil pressure and low power.

"Operational: The crew elected to continue the flight after noting an abnormal egt reading.

"Operational: The crew failed to make the proper initial responses to a power loss and properly execute the autorotation.

"Training: The aircraft commander had not received a proficiency check ride for nearly six months. . . ."

RECOMMENDATIONS:

"That aircraft records be certified as having gone through a review following each scheduled maintenance inspection.

"That periodic classroom reviews be conducted for all assigned aviators on the significance of abnormal instrument readings and the appropriate action to take.

"That flight standardization and training be given increased command emphasis and that quarterly check flights be administered in accordance with current directives, with special emphasis on emergency procedures . . ."

Reviewing authority: "Concur with the findings and recommendations of the aircraft accident investigation board. . . . Aviators in this command obtain sufficient flying time in a short period to gain a high degree of proficiency, except in emergency procedures. During development of the skills required to meet the demands of this operational environment, little time is given to the ever-present possibility of aircraft emergencies. It appears to the inexperienced aviator that he must routinely compromise safety considerations and the possibility of an emergency is something to be considered more seriously only when it happens. Senior rated crewmembers, such as aircraft commanders, provide the largest amount of actual training, but they have not had adequate exposure to emergency procedures and are of little help in this area.

"Discussion of these matters outside the cockpit, both formal and informal, has long been encouraged and has been known to make significant contributions to accident prevention. Flight training, insofar as possible, is accomplished during missions. These methods have serious shortcomings and do not meet the full needs of this command. As the skill level of assigned aviators continues to decrease—and this applies to medium cargo helicopters as well—the need for formal followup training increases. . . .

"The aircraft commander in this case was one of the most experienced in the command. His inability to perform adequately in an emergency situation can be attributed to insufficient organized and scheduled formal flight training."

Indorsement: ". . . The recommendation for aircraft records to be certified as having gone through a review following each scheduled maintenance inspection is considered an unnecessary burden. There are presently adequate safeguards to insure accomplisment of maintenance if existing directives are adhered to. . . .

"Considerable additional command emphasis has recently been placed on the standardization program. The accomplishment of standardization check flights of individuals will be more closely monitored in order to insure compliance with existing directives."

GENTLY, PLEASE!

CH-47A PILOT: "We released our slingload, hovered forward to a clear area, and set the aircraft down. I set the brakes and the ramp was lowered to load a ¼-ton jeep trailer.

"After arrangements were made for ground movement of the trailer, I removed my helmet to wipe the perspiration from my head. I turned to place my helmet on the map case at the rear of the center console. I did not see what took place at that time.

"I felt the bump and, looking down the cargo compartment, I saw fuel escaping from the line on the left side in the ramp area. . . . the AC moved both condition levers to STOP and the aircraft was shut down."

Aircraft commander: ". . . I felt the aft part of the aircraft raise up, looked to the right side of the cockpit and saw the pilot leaning forward in his seat with the cyclic still in his hand. . . . I grabbed the controls, pulled back to place the aft gear back on the ground, and felt and heard a bump.

"The flight engineer said, 'We have a fuel leak. . . .' I immediately pulled both engines to stop, and shut the fuel valves, boost pumps, generators, and master switch off."

Flight engineer: "We were on the ground to pick up an empty jeep trailer. I told the pilot, 'Ramp down,' lowered the ramp and put out the extension. I felt the back of the aircraft leave the ground and then it slammed down hard. I saw fuel from the left side and hydraulic fluid from the right side squirting out and told the pilots to shut down."

Report findings: "Failure to insure cyclic stick was neutral and thrust lever was in 3-degree detent position on landing.

"Pilot accidently pushed forward on cyclic while removing his flight helmet.

"Failure to insure ramp control lever was in STOP position.

"Rapid application of aft cyclic."

Analysis: ". . . the combination of the cyclic stick not being in the neutral position and the thrust lever not fully seated in the 3-degree detent position, coupled with the accidental forward movement of the cyclic, resulted in the aircraft's aft wheels leaving the ground. As the wheels came off, the ramp continued to lower because the ramp control lever was not in the STOP position. . . . the ramp was extended below the aft wheels and, with the sudden application of aft cyclic, the ramp absorbed the impact. . . . The impact caused the bulkhead at station 502.4, attaching point of the ramp actuators, to buckle. This, in turn, severed the left fuel line and the right utility hydraulic line to the ramp valve."

Recommendations: "Continued emphasis on the necessity for crew alertness during all phases of operation, including static operation on the ground.

"Unit SOP to require flight engineer to check ramp control lever after ramp has been lowered to insure it is in the STOP position before he leaves the ramp. . . ."

USAASO Sez

The U.S. Army Aeronautical Service Office discusses

The importance of visual alertness in marginal IFR conditions

Your correspondence on FLIP requirements

On Good Operating Practices: No matter how significantly flight procedures, rules, equipment and experience levels improve, potential mid-air collision hazard remains with us. The importance of visual alertness in marginal IFR conditions should not be ignored; complacency in the see and be seen VFR areas should never be allowed to develop. Pilots can increase protection for themselves and others by remaining constantly alert and compliying with all appropriate rules and procedures.

You should operate under IFR rules whenever circumstances and regulations permit. If operating under VFR, follow the rules and exercise visual alertness during all phases of flight. Considerable help is available via radio communications at airports not served by air traffic control towers. It involves voluntary exchange of traffic information between FSS and UNICOM facilities and pilots. Reports to appropriate facilities of broadcasts "in the blind" should be made (if possible) when inbound to the airport and prior to taxi operations. If in flight, state your position, altitude and intentions. If on the airport, state your location and intentions. In both cases, follow up with appropriate announcements of progress that may be of concern to other pilots in the air and on the ground. FSS stations located on the airport of concern will provide the reported or observed position of other traffic and the runway, wind and airport conditions as known. UNICOM operators can be expected to provide runway wind conditions. Traffic information is provided at their discretion.

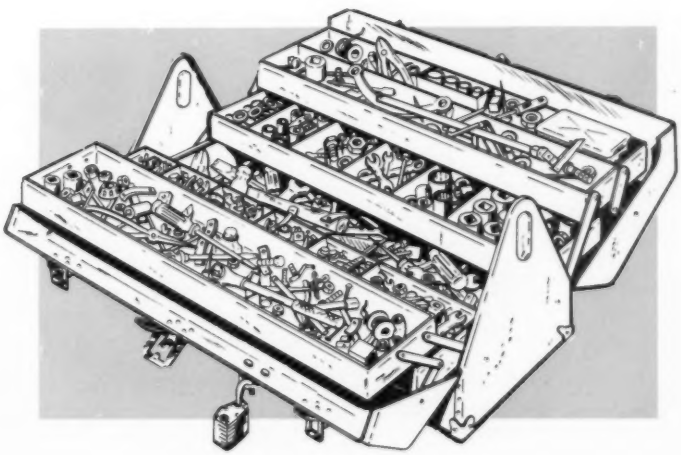
Utilize 123.6 (VHF) for airports having FSS facilities, even during part time out-of-service periods. Utilize the published UNICOM frequency (VHF) at locations not having FSS facilities. Where neither service exists, utilize 122.9 (VHF). In-the-blind broadcasts should be made on these frequencies as appropriate. If you are UHF only equipped, monitor the VHF frequency on your VOR (VHF) receiver.

Stay alert—Stay alive!!

On FLIP Correspondence: While we like to think that we give you personalized service in providing aeronautical information products, we're no different from other agencies in this age of computers. Therefore, to get a rapid response to your correspondence on FLIP requirements, always make reference to your account number. This appears as the first item on the address label, i.e., "A4321."

The Case for Toolbox Inventory After All Maintenance

This 3/8" by 7/16" box end wrench and cotter pin extractor were found in the burned wreckage of a helicopter involved in a catastrophic accident



POLAR UNIT RETURNS HOME

Antarctic Exploration May Affect 'Continental Drift' Theory

South Polar camps are quickly drifted in by snow

SCIENTISTS TRANSPORTED by an aviation detachment from Ft. Eustis, Va., have found fossilized plant material in the Jones Mountains of Antarctica—an area in which scientists previously believed that such material did not exist.

"This may have some effect on the credibility of the theory of continental drift," said MAJ Bennie E. Luck Jr., commander of the detachment which has just returned from three months on the Southern-most continent. The continental drift theory suggests that many of the continents were originally one land mass that has separated.

During the past three months of the Antarctic summer, the 13-man detachment provided helicopter transportation to scientists from Russia, Japan, Chile and the United States who were making a complete scientific survey of the Hudson and Jones Mountains and Thurston Island in Ellsworth Land.

From two camps in the midst of the remote area—described as 3,800 miles from the nearest drug store—soldiers in the detachment maintained and flew three specially equipped UH-1D helicopters as far as 165 miles from the camp.

In addition to those making detailed maps of the area, other scientists were studying geology and biology. Temperatures ranged from 30 below zero to 35 above on warm days.

"The geologists were working very closely with the mapmakers in order to pinpoint formations which had been seen from the air but sometimes inaccurately marked," said Major Luck. He commented that the biologists were interested not only in the rock outcrops but in the coastal areas where there were penguins, seals and whales.

In addition they found some protozoa, an elementary animal life form, in pools of melted ice.

Now that they are back in Virginia, the helicopter detachment members plan to celebrate New Year's Eve. There were elaborate Thanksgiving and Christmas celebrations with all the proper food and decorations because the unit was weathered in and couldn't work.

On New Year's Eve, the weather was good and the men worked through the holiday. It was January 17 before they could celebrate, so they decided to wait and observe the holiday in Virginia.